With the FWTP in place, The Wink – Culberson – Yucca Drive Loop could still withstand an increase above current load projections. Figure 16 below shows the FWTP under these conditions with the same N-1-1 contingency. This means that the FWTP will not only resolve the current issues of voltage collapse and load loss, but will also provide ample transmission capacity for load growth well into the future.

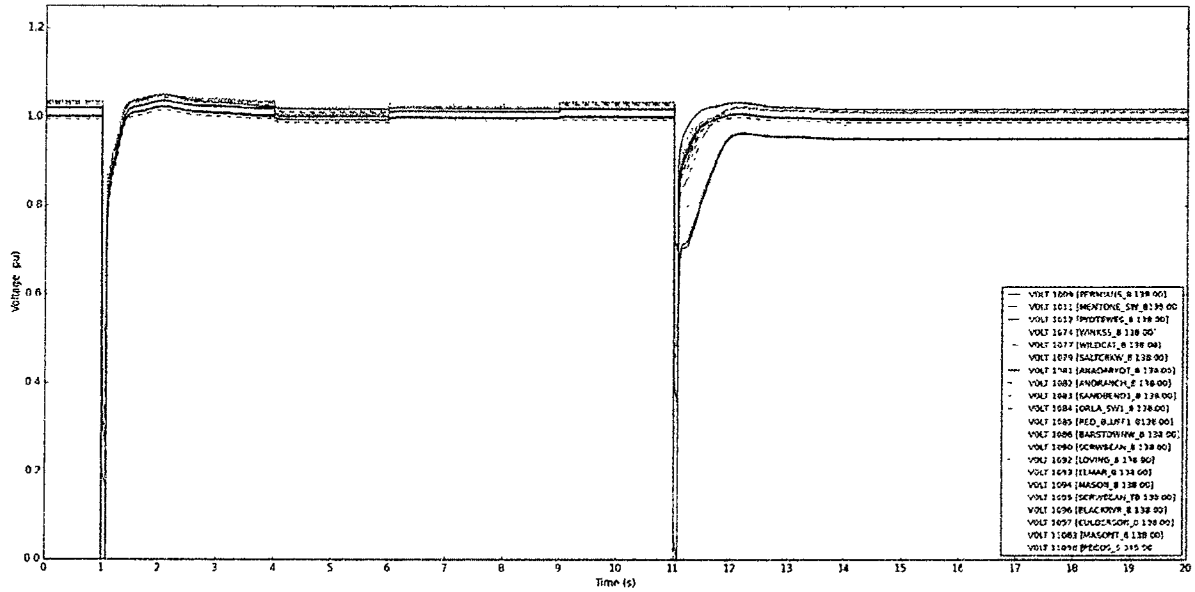

Figure 16 – Dynamic Voltage Response of Wink – Culberson – Yucca Drive Loop for N-1-1 contingency – Far West Texas Project

With no 345 kV source into The Barrilla Junction Area, AEP studies show that the remaining 69 kV and 138 kV lines in the Barrilla Junction Area that have not been addressed by the Barrilla Junction Area Improvement Project would need to be rebuilt. This equates to more than 170 miles of existing 69 kV and 138 kV transmission lines.

While rebuilding the existing corridor of transmission lines in The Barrilla Junction Area would address the thermal overloading concerns, this alternative does not provide a new transmission path into The Barrilla Junction Area for any new solar generation in the region to interconnect. Additional new source paths may be needed in the area to accommodate growth beyond what has been studied. AEP studies have also shown the 345 kV option to perform better under the same contingency and dispatch scenarios as this alternative and provides for additional transfers on the existing Ft. Stockton Plant – Rio Pecos paths.

Conclusion

The joint decision by AEP and Oncor to construct the Far West Texas Project will provide a backbone 345 kV infrastructure to support load growth, support voltage, improve system protection issues and provide pathways for new generation interconnects in the region southwest of Odessa. The Far West Texas Project will help support transmission voltage in the Delaware Basin area both pre- and post-contingency by providing a strong source into an area that is primarily served by 138 kV and 69 kV transmission lines, and addresses reliability issues for AEP, Oncor and other TSPs.

Additionally, the Far West Texas Project would also allow flexibility for future 345 and 138 kV lines, future autotransformers, and additional connections between TSPs as needs dictate. It is the best overall solution to create a resilient transmission system in Far West Texas, an area that is expected to have substantial future load growth and generation penetration.

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RE: Far West Texas project

On June 13, 2017 the Electric Reliability Council of Texas (ERCOT) Board of Directors recommended the following Tier 1 transmission project as needed to support the reliability of the ERCOT Regional transmission system:

Far West Texas project:

- Expand the Riverton Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers
- Construct a new approximately 85-mile 345 kV line on double-circuit structures with one circuit in place, between Moss and Riverton Switch Station. Add a second circuit to the existing 16-mile Moss Switch Station – Odessa EHV 345 kV double-circuit structures. Install 345 kV circuit breaker(s) at Odessa EHV Switch Station. Connect the new circuit from Riverton Switch Station and terminate at Odessa EHV Switch Station to create the new Odessa EHV – Riverton 345 kV line
- Expand the Solstice Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers
- Construct a new approximately 68-mile 345 kV line from Solstice Switch Station to Bakersfield Station on double-circuit structures with one circuit in place

ATTACHMENT NO. 7

Additional details on this project are included in the Attachment A to this letter.

This project was supported throughout the ERCOT planning process, which included participation of all market segments through the ERCOT RPG. ERCOT's recommendation to the Board was reviewed by the ERCOT Regional Planning Group and the ERCOT Technical Advisory Committee (TAC). ERCOT staff looks forward to the successful completion of the work and is ready to assist you with any planning and operations related activities.

Should you have any questions please contact me at any time.

Sincerely,

DW Ri

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Vice President, Grid Planning and Operations
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ERCOT Independent Review of the AEPSC and Oncor Far West Texas Project

Version 1.0

Document Revisions

Date	Version	Description	Author(s)
05/23/2017	1.0	Final	A. Benjamin Richardson, Ramya Nagarajan, Ehsan Rehman, Ying Li, Yunzhi Cheng
		Reviewed by	Prabhu Gnanam, Fred Huang Jeff Billo

Table of Contents

1. Executive Summary

Over the past several years the load on the Wink – Culberson – Yucca Drive 138 kV transmission loop ("Culberson loop") and the load in the Barilla Junction area have experienced high load growth. Oncor has projected annual load growth rates as high as 11% over the next five years on the Culberson loop. Additionally, both areas, located in Far West Texas, have had an increase in requests for generator interconnections. Over 1,600 MW of solar resources are expected to come online in Pecos and Southwest Upton Counties between 2016 and 2020.

On April 20, 2016, Oncor and AEPSC submitted the Far West Texas Project (FWTP) to the Regional Planning Group (RPG) to address the transmission needs both in the Culberson loop area and the Barilla Junction area. The proposed project was estimated to cost $423 million and classified as a Tier 1 project. The proposed in-service date range for the FWTP was 2021-2022.

Based on the FWTP proposal, ERCOT completed this independent review to determine the system needs and address those needs in a cost-effective manner while providing the flexibility to meet potential load and generating capacity growth in this region. ERCOT also performed sensitivity studies in compliance with the ERCOT Planning Guide.

Based on the forecasted loads and scenarios analyzed, ERCOT determined that there is a reliability need to improve the transmission system in Far West Texas. After consideration of the project alternatives, ERCOT concluded that the upgrades identified in Option 2 meet the reliability criteria in the most cost effective manner and have multiple expansion paths to accommodate future load growth in the area of study. Option 2 is estimated to cost $336 million and is described as follows:

- Expand the Riverton Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers
- Construct a new, approximately 85-mile, 345 kV line on double-circuit structures with one circuit in place, between Moss and Riverton Switch Station, Add a second circuit to the existing 16-mile Moss Switch Station – Odessa EHV 345 kV double-circuit structures. Install 345 kV circuit breaker(s) at Odessa EHV Switch Station. Connect the new circuit from Riverton Switch Station and terminate at Odessa EHV Switch Station to create the new Odessa EHV – Riverton 345 kV Line
- Expand the Solstice Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers
- Construct a new, approximately 68-mile, 345 kV line from Solstice Switch Station to Bakersfield Station on double-circuit structures with one circuit in place

Although this option is not the exact configuration included in the FWTP proposal, it is a subset of that configuration with two autotransformer additions. ERCOT has determined that the alternative transmission expansion option, Option 2, will provide the most cost-effective configuration to meet the load forecast developed from contractual agreements. It will also allow a number of different possible expansion options that could augment the Far West Texas transmission grid load serving capability beyond the forecasts developed exclusively from committed load additions.

2. Introduction

Over the past several years the Far West Texas Weather Zone has experienced high load growth. Between 2010 and 2016 the average annual growth rate was roughly 8%. This strong growth rate was primarily driven by increases in oil and natural gas related demand. The most recent ERCOT 90th percentile summer non-coincident peak load forecast projects an average annual Far West Weather Zone growth rate of about 2.4% between 2016 and 2020.

Figure 2.1 shows historic and projected summer non-coincident peak load levels for the Far West Weather Zone.

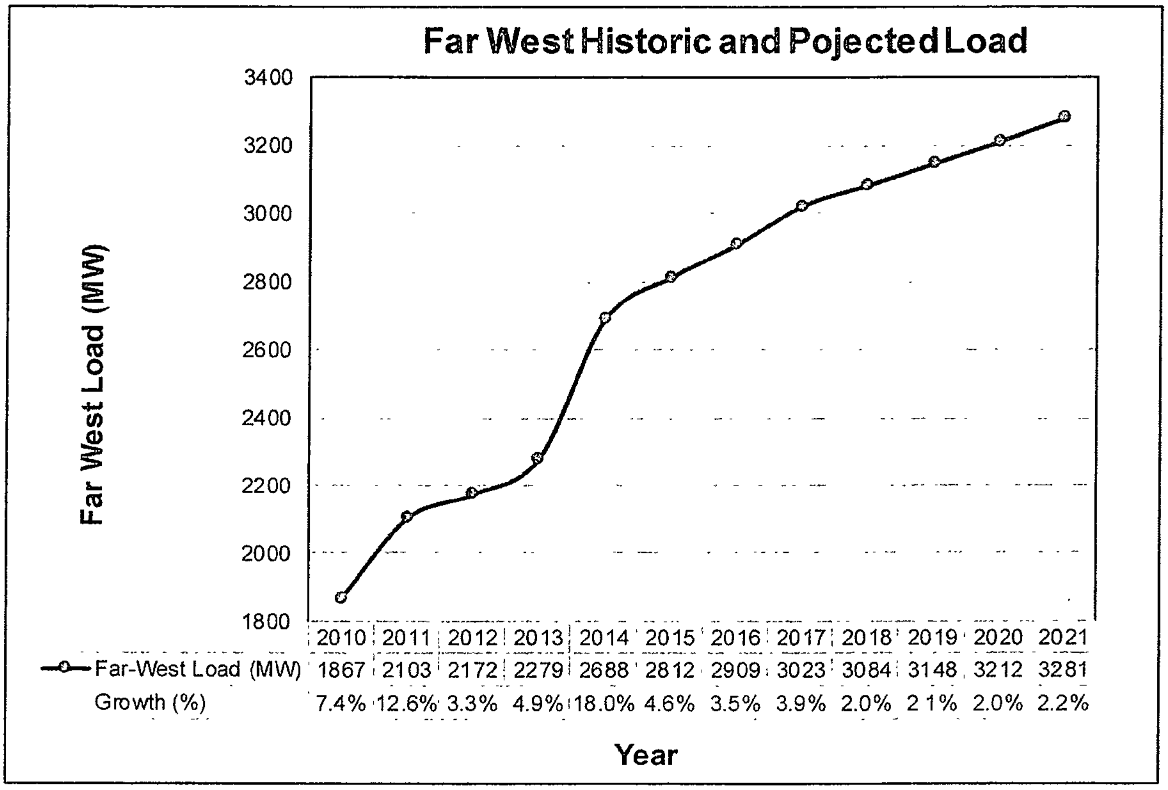


Figure 2.1: Far West Weather Zone historic peak load and ERCOT 90th percentile summer non-coincident peak load forecast

The Transmission Service Providers (TSPs) in the area including Oncor, TNMP and AEPSC have also identified high load growth rates concentrated in the Delaware Basin area. Oncor has projected annual load growth rates ranging as high as 11% over the next five years within a portion of the Far West Weather Zone, including Culberson, Reeves, Loving, Ward and Winkler Counties, based on committed customer load requests.

The area southwest of Odessa, served by the 69 kV and 138 kV lines between Permian Basin, Barilla Junction, Fort Stockton Plant, and Rio Pecos stations ("Barilla Junction area") has seen increased load growth along with solar generation development. AEPSC has projected that the Barilla Junction area load will grow to over 500 MW by 2021 with over 160 MW being served by the Yucca Drive – Barilla Junction 138 kV line alone. There are over 1,600 MW of solar resources that meet the conditions of Planning Guide Section 6.9 for inclusion in the base cases and that are expected to come online in Pecos and Southwest Upton Counties between 2016 and 2020. These generators are listed in Table 2.1.

Table 2.1 Solar Generation coming online in Pecos and Upton between 2016 and 2020

INR	Project Name	Fuel	Projected COD	Total Capacity	County
12INR0059b	Barilla Solar 1B	Solar	7/1/2016	7	Pecos
16INR0048	RE Rose Rock Solar	Solar	10/31/2016	160	Pecos
16INR0073	East Pecos Solar	Solar	12/1/2016	120	Pecos
16INR0065	Castle Gap Solar	Solar	1/11/2017	117	Upton
15INR0070_1	West Texas Solar	Solar	2/1/2017	110	Pecos
15INR0045	Riggins Solar	Solar	2/16/2017	150	Pecos
15INR0070_1b	Pearl Solar	Solar	4/28/2017	50	Pecos
16INR0065b	SP-TX-12-Phase B	Solar	8/15/2017	120	Upton
16INR0065a	Castle Gap Solar 2	Solar	9/6/2017	63	Upton
17INR0020a	RE Maplewood 2a Solar	Solar	10/1/2018	100	Pecos
16INR0114	Upton Solar	Solar	12/1/2018	102	Upton
15INR0059	Pecos Solar I	Solar	1/1/2019	108	Pecos
17INR0020b	RE Maplewood 2b Solar	Solar	5/16/2019	200	Pecos
17INR0020c	RE Maplewood 2c Solar	Solar	1/1/2020	100	Pecos
17INR0020d	RE Maplewood 2d Solar	Solar	7/15/2020	100	Pecos

On April 20, 2016, Oncor and AEPSC submitted the Far West Texas Project (FWTP) to the Regional Planning Group (RPG) to address the transmission needs both in the Barilla Junction area and the Wink – Culberson – Yucca Drive 138 kV transmission loop ("Culberson loop"). This project was estimated to cost $423 million and was classified as a Tier 1 project. Figure 2.2 shows the proposed FWTP. The major components of this project proposal were:

- A new 101-mile Odessa EHV – Riverton 345 kV line on a double circuit structure with a single circuit installed
- Expansion of the Riverton Switch Station to install a 3-breaker 345 kV ring-bus arrangement with one 600 MVA, 345/138 kV autotransformer
- Expansion of the Solstice Switch Station to install a 3-breaker 345 kV ring-bus arrangement with one 675 MVA, 345/138 kV autotransformer
- A new 66-mile Riverton – Solstice 345 kV line on a double circuit structure with a single circuit installed
- A new 345 kV Lynx Switch Station with a 5-breaker 345 kV ring-bus arrangement and one 675 MVA, 345/138 kV autotransformer
- A new 59-mile Solstice – Lynx 345 kV Line on a double circuit structure with a single circuit installed
- A new 9-mile Lynx – Bakersfield 345 kV Line on a double circuit structure with a single circuit installed

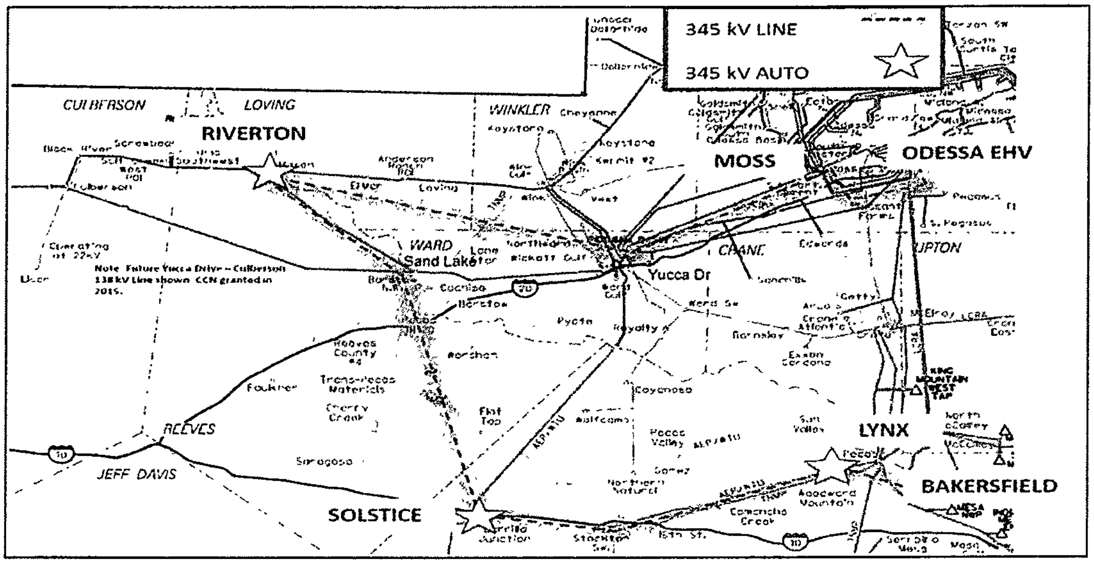


Figure 2.2: Proposed Far West Texas Project

Based on the FWTP proposal, ERCOT completed this independent review to determine the system needs in the Barilla Junction and Culberson loop areas and address those needs in a cost-effective manner while providing the flexibility to meet potential load and generating capacity growth in this region.

3. Study Assumption and Methodology

ERCOT performed studies under various system conditions to evaluate the system need and identify a cost-effective solution to meet those needs in the area. The assumptions and criteria used for this review are described in this section.

3.1. Study Assumption

The primary focus of this review are the Barilla Junction Area and Wink – Culberson – Yucca Drive loop transmission system.

Figure 3.1 shows the system map of the study area. The Barilla Junction and Culberson loop areas are highlighted in rectangles.

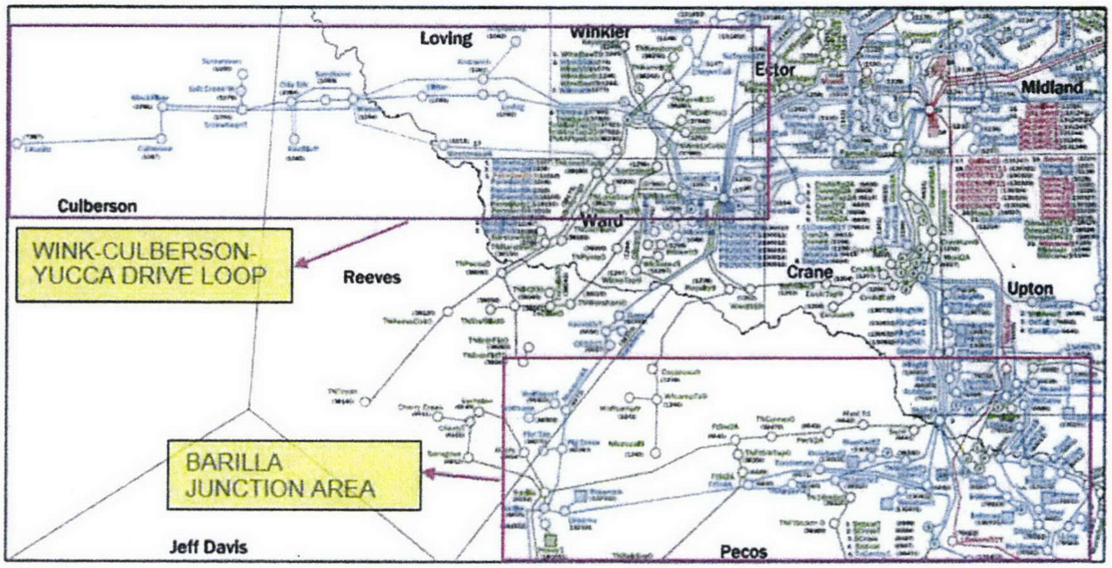


Figure 3.1: Transmission System Map of Study Area

3.1.1. Reliability Cases

The following starting cases were used in the study:

- The 2021 West/Far West (WFW) summer peak case from the 2016 RTP (based on the 2015 Steady State Working Group (SSWG) cases)
- The 2022 Dynamic Working Group summer peak flat start case

3.1.2. Transmission Topology

The starting case was modified based on input from AEPSC and Oncor to include topological changes, switched shunt additions and load additions in the study area. AEPSC provided system changes to the 138 kV line from Pig Creek to Yucca Drive via Gas Pad Tap. This section was upgraded to 966 MVA. The changes also included a switched shunt device at Hackberry Draw Tap 138 kV substation.

Oncor also provided topological updates to the Wink – Culberson – Yucca Drive loop. The changes included the new Riverton and Mentone substations, and a new Riverton-Mentone-Sand Lake 138 kV line along with other new buses and branches to accommodate new load additions in the Culberson loop. The changes also included a switched shunt added to the Whiting Oil 138 kV bus.

3.1.3. Study Case Loads and Potential Loads

The TSPs also provided data which increased the load in the Barilla Junction and Culberson loop areas. The original Oncor and AEPSC RPG submittal data included about 425 MW of load in the Culberson loop area and 511 MW in the Barilla Junction area by year 2021. These projections were later modified by Oncor to include additional confirmed load contracts for the Culberson loop during the ERCOT independent review. AEPSC also provided updated load information for the Barilla Junction area and some of the loads originally designated as conforming were modified to be non-conforming. After all the changes were incorporated the "Study Case" for 2021 had a total projected load of 533 MW along the Culberson loop and 511 MW of total load in the Barilla Junction area. Both AEPSC and Oncor met with ERCOT and shared information on the signed customer agreements and confirmed these proposed load additions.

Sensitivity cases were also created to reflect higher load projections from Oncor and AEPSC. These cases contained additional customer load requests that did not yet have firm commitment at the time of this independent review. To reflect this "Potential" load growth, the load was increased by 277 MW in the Culberson loop and 57 MW in the Barilla Junction area above the Study Case load. The total load in the Potential Load Case was approximately 810 MW and 568 MW in the Culberson loop and Barilla Junction area, respectively, for the Potential Load sensitivity.

3.1.4. Generation

Planned generators in the Far West and West Weather Zones that met Planning Guide Section 6.9 conditions for inclusion in the base cases (according to the 2016 October Generation Interconnection Status report), which were not included in the RTP cases, were added. The added generators are listed in Table 3.1.

Key assumptions applied in this study include the following:

- Wind generation in West and Far West weather zones were set to have a maximum dispatch capability of 2.6% of their rated capacity. This assumption was in accordance with the 2016 Regional Transmission Plan Study Scope and Process document[1].
- Solar generation was set at 70% of their rated capacity in accordance with the 2016 Regional Transmission Plan Study Scope and Process document.

Table 3.1 Added Generators That Met Planning Guide Section 6.9 Conditions (2016 October GIS report)

GINR Number	Project Name	MW	Fuel	County	Weather Zone
16INR0023	BNB Lamesa Solar (Phase I)	102	Solar	Dawson	Far West
16INR0065a	Castle Gap Solar 2	63	Solar	Upton	Far West
17INR0020a	RE Maplewood 2a Solar	100	Solar	Pecos	Far West
17INR0020b	RE Maplewood 2b Solar	200	Solar	Pecos	Far West
17INR0020c	RE Maplewood 2c Solar	100	Solar	Pecos	Far West
17INR0020d	RE Maplewood 2d Solar	100	Solar	Pecos	Far West
15INR0061	Solaire Holman 1	50	Solar	Brewster	Far West

3.1.5. No Solar Scenarios

The Far West and West Weather Zones have a significant amount of solar generation, and the maximum output of solar generation modeled in the Study Case and the Potential Load Case was

[1] http://www.ercot.com/content/wcm/key_documents_lists/77730/2016_RTP_Scope_Process_v1.3_clean.pdf

1,340 MW based on limiting the dispatch to about 70% of maximum capacity (maximum capacity was about 1,912 MW). To study system conditions when solar generation is not available, a 9:00 pm summer peak load condition case was created for both the Study Cases and Potential Load Cases. To create this "No Solar" peak condition, the load in the Far West Weather Zone was reduced by 6% based on a review of the historic Far West Weather Zone summer peak conditions from 2014-2016 at the time of peak and at 9:00 pm when the sun has set and solar generation output is expected to be near zero. Therefore, the load was scaled down in the Far West Weather Zone to reflect expected demand conditions at 9:00 pm for the "No Solar" scenarios.

3.1.6. Capital Cost Estimates

Capital costs estimates for transmission facilities were provided by Oncor, AEPSC and LCRA TSC. These cost were provided for individual transmission facilities and ERCOT used those values to calculate total project costs for various project options.

3.2. Criteria for Violations

All the violations identified in this report used the criteria described in this section.

All 100 kV and above busses, transmission lines, and transformers in the study region were monitored (excluding generator step-up transformers).

- Thermal violation
    - Use Rate A for Normal Conditions
    - Use Rate B for Emergency Conditions
- Voltage violation criteria
    - 0.95 < V pu < 1.05 Normal
    - 0.90 < V pu < 1.05 Emergency
    - Post Contingency voltage deviations
        - > 8% on non-radial load buses
- Voltage Stability Analysis
    - PV calculations for load transfer (Culberson loop)

3.3. Study Tools

ERCOT utilized the following software tools for the independent review of the Far West Texas Project:

- PSS/e version 33 was used to perform the dynamic stability analysis and to incorporate the TSP changes (idevs) in the initial steady-state case
- PowerWorld Simulator version 19 for SCOPF and steady state contingency analysis
- VSAT version 15 was used for voltage stability analysis
- UPLAN

4. Project Need

The need for a transmission improvement project was evaluated for the Study Case with both the base case and "No Solar" scenarios. The steady state analysis results showed transmission line overloading in the Barilla Junction area and voltage instability (unsolved contingencies) in the Culberson loop area under N–1 contingency analysis. The results of the steady state violations are summarized in Tables 4.1 – 4.4.

Table 4.1 2021 Thermal Overloading in the Study Region under N-1 Conditions

Element	Length (miles)	Study Case	No Solar Case
16th Street TNP to Woodward2 138 kV ckt 1	31.8	101%	115%
Rio Pecos to Woodward2 138 kV ckt 1	1.9	No Violation	106%
Rio Pecos to Woodward1 Tap 138 kV ckt 1	2 2	No Violation	106%
Tombstone to Woodward1 Tap 138 kV ckt 1	15.7	No Violation	106%

Table 4.2 2021 Unsolvable contingencies

#	Contingency (Category)	Study Case	No Solar Case
1	CEII	Unsolved	Unsolved

Table 4.3 2021 Voltage Violations in the Study Region under N-1 Conditions

Bus	Nominal Voltage (KV)	Study Case	No Solar Case
Salt Creek South Poi	138	0.873	0.893
Black River	138	0.878	0.896
Mentone SW	138	0.880	0.897
Mentcryo	138	0.885	0.898
Coalsndr	138	0.880	0.898
Sandlake	138	0.881	0.898
Sand Bend Poi	138	0.877	0.898
Culberson2	138	0.880	0.898
Orla Plant	138	0.865	0.899
Culberson	138	0.881	0.899
Culberson Wind Farm	138	0.881	0.899
Elmar	138	0.890	No Violation
Kunitz	138	0.883	No Violation
Mason (Oncor)	138	0.885	No Violation
Orla Southwest Poi	138	0.869	No Violation
Riverton	138	0.878	No Violation
Salt Creek West Poi	138	0.880	No Violation
Screwbean Tap	138	0 881	No Violation

Table 4.4 2021 Voltage Deviations in the Study Region under N-1 Conditions

Bus	Nominal Voltage (KV)	Study Case	No Solar Case
Kunitz	138	< 8%	9.2%
Mason (Oncor)	138	< 8%	8.7%
Orla Southwest Poi	138	< 8%	9.0%
Pig Creek Tap	138	< 8%	8.6%
Riverton	138	< 8%	8.8%
Salt Creek West Poi	138	< 8%	9.1 %
Screwbean Tap	138	< 8%	9.1%
Wolfbone Tap TNP	138	< 8%	10.0%
Woodward 1 Tap	138	< 8%	8.5%
Woodward 1	138	< 8%	8.5%

The unsolvable contingency identified in Table 4.2 and voltage violations listed in Table 4.4 indicated a local voltage stability challenge in the Culberson loop area. The detailed steady state results for the Study Case with and without solar can be found in the Appendix.

Figure 4.1 shows the thermal violations seen in the Study case.

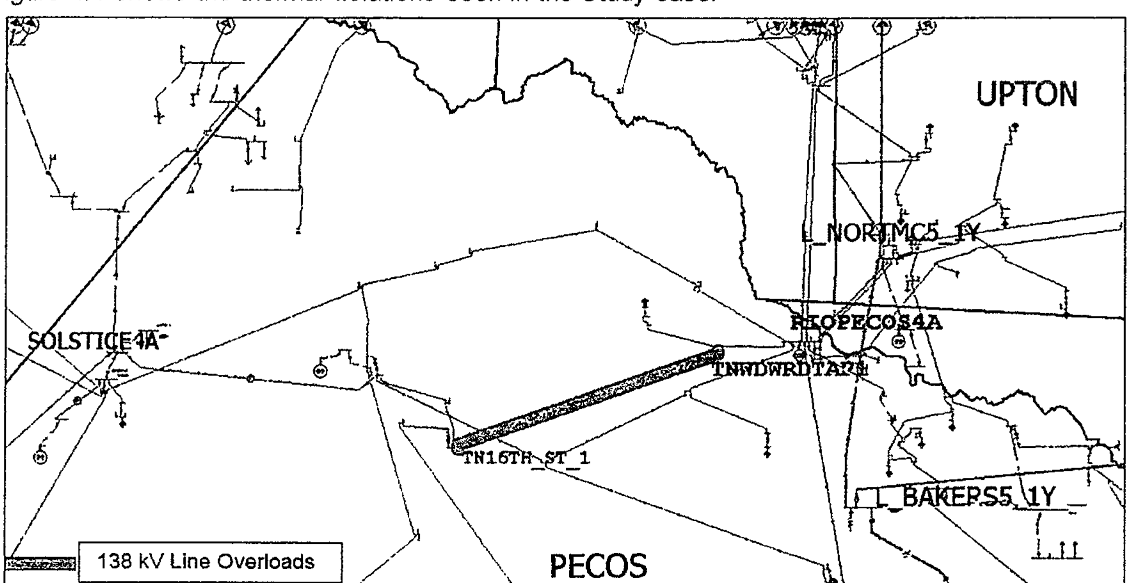


Figure 4.1: Study Case Thermal Violations in Study area

Figure 4.2 shows the voltage violations seen in the Study case.

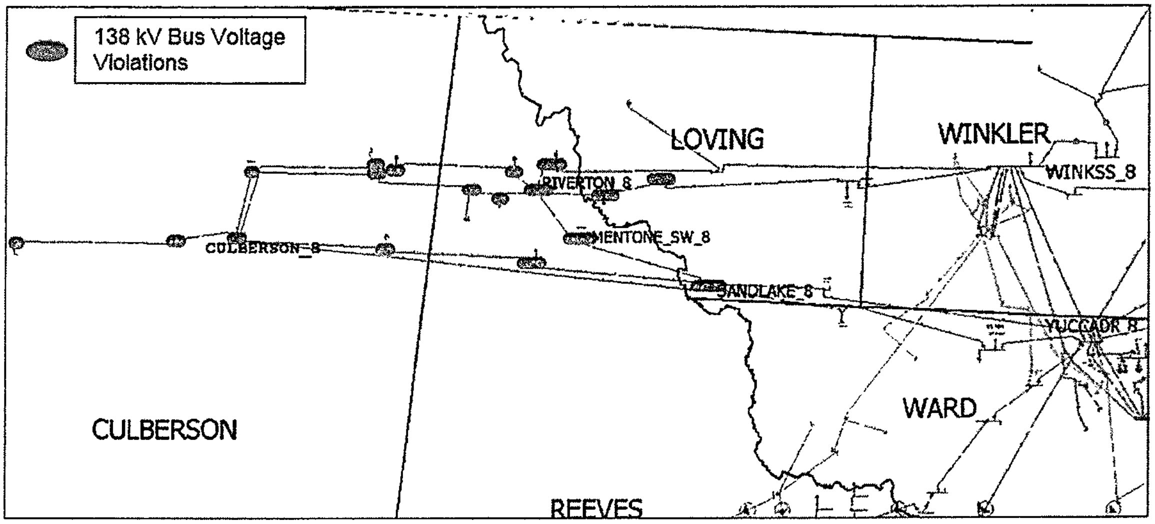


Figure 4.2: Study Case Voltage Violations in Study area

Figure 4.3 shows the thermal violations seen in the No Solar case.

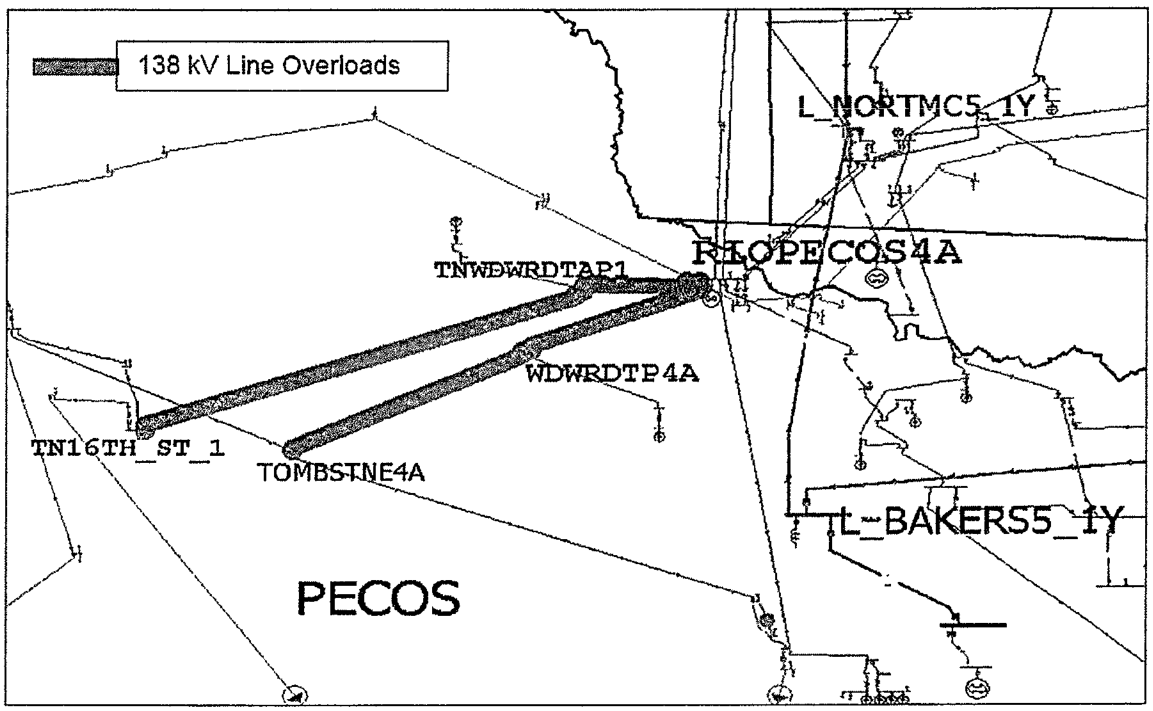


Figure 4.3: No Solar Case Thermal Violations in Study area

Figure 4.4 shows the voltage violations seen in the No Solar case.

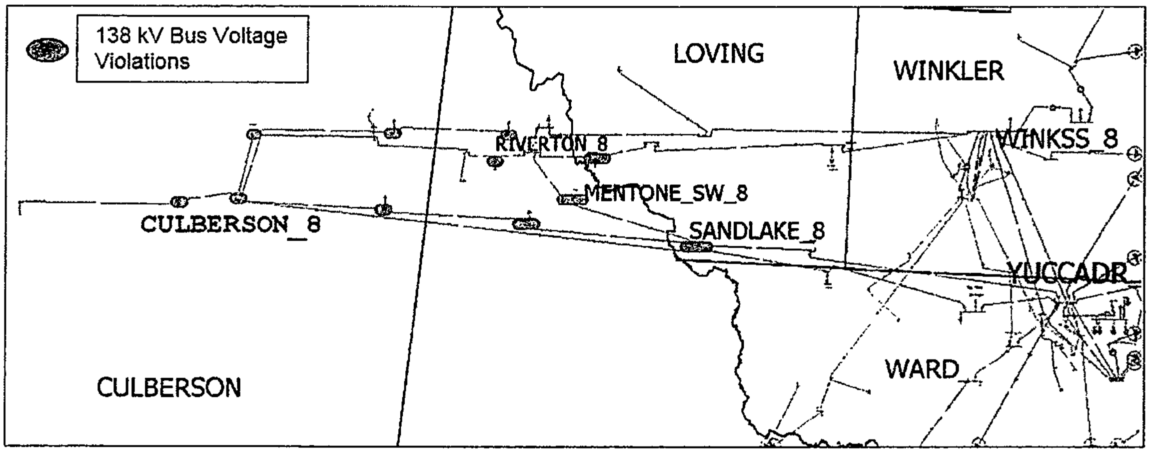


Figure 4.4: No Solar Case Voltage Violations in Study area

Both steady state and dynamic stability analyses identified reliability issues under the NERC and ERCOT reliability criteria.

5. Project Options

To address the reliability needs in the study area, ERCOT initially examined the FWTP proposal submitted by the TSPs in combination with nearly 40 alternatives.

5.1. Initial Options

An initial set of options (alternatives) was developed to address the identified reliability criteria violations for the Study Case while also considering an upgrade path to address potential needs in the future. This was accomplished by beginning with the simplest 138 kV expansion alternatives and then expanded to address performance violations. ERCOT also attempted to minimize the project cost. The ERCOT 2016 Long-Term System Assessment[2], which identified a long-term need for a project in the area, was also considered when developing the initial set of options.

The 40 alternatives could be described as variations of about 9 different transmission solutions, the variations created by using different 138 kV and 345 kV voltage class facilities; various termination points for new transmission lines; and various reactive compensation. Accordingly, diagrams of project options with cost estimates and a summary of reliability performance findings are provided in the Appendix for the 9 major transmission solutions.

Cost and reliability performance comparisons were used to narrow the 9 major solution options to the short-listed options discussed next. Generally, the short-listed options are also variations of the FWTP originally proposed by the TSPs.

5.2. Short-Listed Options

Among all the initial options, a final number of four options were studied further. The detailed description of the four short-list options are provided below and diagrams for these are included in the Appendix.

- **Option 1**
    - Install a new 200 MVAR Dynamic Synchronous Condenser at Mentone 138 kV substation
    - Install a new 200 MVAR Dynamic Synchronous Condenser at Culberson 138 kV substation
    - Construct a new approximately 85-mile 345 kV line operating at 138 kV on double-circuit structures with one circuit in place, between Moss and Riverton Switch Station. Add a second circuit to the existing 16-mile Moss Switch Station – Odessa EHV 345 kV double-circuit structures. Connect the new circuit from Riverton Switch Station and terminate at Odessa EHV to create the new Odessa EHV - Riverton 345 kV line operating at 138 kV.
    - Build a new McCamey – Fort Stockton 345 kV double circuit line operating at 138 kV (requiring approximately 47-miles of new Right of Way)
    - Build a new Pig Creek – Fort Stockton 345 kV single circuit line operating at 138 kV (requiring approximately 39-miles of new Right of Way)
    - Install a new 50 MVAR capacitor bank each at Mentone and Salt Creek 138 kV substations

[2] http://www.ercot.com/content/wcm/lists/89476/2016_Long_Term_System_Assessment_for_the_ERCOT_Region.pdf

- Install a new 18 MVAR capacitor bank each at Orla, Elmar, Loving and Alamito Creek 138 kV substation
- Install a new 3.6 MVAR capacitor bank Espy Wells 69 kV substation
- Install a new 10.8 MVAR capacitor bank at Shafter Goldmine 69 kV substation
- Install a new 7.2 MVAR capacitor bank at Sanderson TNP 69 kV substation

The total cost estimate for Option 1 is approximately $464 Million.

- **Option 2**
  - Expand the Riverton Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformer
  - Construct a new approximately 85-mile 345 kV line on double-circuit structures with one circuit in place, between Moss and Riverton Switch Station. Add a second circuit to the existing 16-mile Moss Switch Station – Odessa EHV 345 kV double-circuit structures. Install 345 kV circuit breaker(s) at Odessa EHV. Connect the new circuit from Riverton Switch Station and terminate at Odessa EHV to create the new Odessa EHV – Riverton 345 kV Line
  - Expand the Solstice Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformer
  - Construct a new approximately 68-mile 345 kV line from Solstice Switch Station to Bakersfield station on double-circuit structures with one circuit in place

The total cost estimate for Option 2 is approximately $336 Million.

- **Option 3**
  - Expand the Riverton Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformer
  - Construct a new approximately 85-mile 345 kV line on double-circuit structures with one circuit in place, between Moss and Riverton Switch Station. Add a second circuit to the existing 16-mile Moss Switch Station – Odessa EHV 345 kV double-circuit structures. Install 345 kV circuit breaker(s) at Odessa EHV. Connect the new circuit from Riverton Switch Station and terminate at Odessa EHV to create the new Odessa EHV – Riverton 345 kV Line
  - Expand the Riverton Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformer
  - Expand the Sand Lake Switch Station to install a 345 kV ring-bus arrangement with one 600 MVA, 345/138 kV autotransformer
  - Expand the Solstice Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformer
  - Construct a new approximately 41-mile 345 kV line on double-circuit structures with one circuit in place, Sandlake – Solstice 345 kV single circuit line (requiring approximately 41 miles of new Right of Way).
  - Add a second circuit to the Riverton – Mentone – Sand Lake 345 kV to create a Riverton – Sand Lake 345 kV line on the existing Riverton – Mentone – Sandlake 345 kV line operating at 138 kV.

- Construct a new approximately 68-mile 345 kV line from Solstice Switch Station to Bakersfield station on double-circuit structures with one circuit in place

The total cost estimate for Option 3 is approximately $446 Million.

- **Option 4**
  - Option 4 is same as Option 3 with an additional new 200 MVAR Synchronous Condenser at Culberson 138 kV substation.

The total cost estimate for Option 4 is approximately $501 Million.

6. Steady-State Performance of Short-listed Options

To compare and contrast each of the options several analyses were performed. This Section discusses the performance of the four short-listed options under N-1 (NERC P1, P2-1 and P7) steady state contingency conditions for the studied scenarios.

Table 6.1 Steady State Reliability Assessment of All Final Options under N-1 (NERC P1, P2-1 and P7)

Load Level	Violation Type	Case	Option 1	Option 2	Option 3	Option 4
Study Case (533 MW in Culberson loop; 511 MW in Barilla Junction area)	Thermal	With Solar	No Violations	No Violations	No Violations	No Violations
		No Solar	No Violations	No Violations	No Violations	No Violations
	Voltage	With Solar	No Violations	No Violations	No Violations	No Violations
		No Solar	No Violations	No Violations	No Violations	No Violations
Potential Load Case (810 MW in Culberson loop; 568 MW in Barilla Junction area)	Thermal	With Solar	*Violations*	*Violations*	No Violations	No Violations
		No Solar	*Violations*	*Violations*	No Violations	No Violations
	Voltage	With Solar	No Violations	*Violations*	No Violations	No Violations
		No Solar	No Violations	*Violations*	No Violations	No Violations

The steady state results showed that all of the four options addressed the reliability needs in the Culberson loop and Barilla Junction area with Study Case load conditions. In the Potential Load scenario there were violations for Options 1 and 2. Option 3 and 4 showed no violations even under the Potential Load scenario. Option 3 had a voltage deviation of over 8% at Orla 138 kV substation in the Potential Loads case. It should be noted that there were some violations that were more severe in the cases that had solar generation than in the No Solar scenarios as these cases all reflected summer peak loading conditions while the No Solar cases had a slightly lower load level. A complete list of branch and voltage violations and the corresponding contingencies are provided in the Appendix.

7. Voltage Stability Analysis

A voltage stability analysis was conducted for the Culberson loop area for all short-listed options. The No Solar scenario represents the most stressed system condition from a voltage stability perspective and was therefore tested for all of the short-listed options. A Power-Voltage (PV) stability assessment was used to proportionally increase the load in the Culberson loop until a voltage collapse identified the maximum load serving capability for these options. The PV analysis included NERC P1, selected P6, and P7 contingency events. Table 7.1 shows the maximum load in the Culberson loop area to be reliably served as identified in the voltage stability analysis. All of the short-listed options provide more than a 10% voltage stability load margin when compared to the Study Case load level.

Table 7.1 Voltage Stability Assessment of All Final Options

Description	Option 1	Option 2	Option 3	Option 4
PV Results Culberson loop Load Served (MW)	917	717	917	1037

8. Economic Analysis

Although this RPG project is driven by reliability needs, ERCOT also conducted an economic analysis to compare the relative performance of each of the final options in terms of production cost savings.

The base case for this economic analysis used the 2022 economic case built for the 2016 RTP as the starting case. The topology changes and generation additions were similar to the steady state base case built. The load was modified to reflect the demand in the RPG proposal, but a 50/50 load scenario was used in ERCOT economic analysis, whereas the steady state analysis used a 90/10 load scenario. ERCOT modeled each of the four final options and performed production cost simulations for the year 2022. The annual production cost under each select option was compared to the option yielding the highest annual production cost in order to obtain a relative annual production cost saving for each option.

As shown in Table 8.1, the results indicates that Options 2 to 4 have over $6 million annual production cost savings compared to Option 1. This relative improvement in savings is due to the loss savings achieved by operating the new transmission lines at 345 kV. This apart, Options 2 to 4 showed no significant difference in congestion.

Table 8.1 Relative annual production cost savings (referenced to Option 1), in $ Million

Option	Option 1	Option 2	Option 3	Option 4
Relative Annual Production Cost Savings (referenced to Option 1)	-	6.2	6.6	6 6

9. Final Options Comparison

As shown in Table 9.1, a comparison of study results for the short-listed options shows that Option 2 met the system reliability criteria under the Study Case load conditions while deferring more than $100 million in capital expenditures when compared to the other options. Option 2 also resulted in lower system production costs when compared to Option 1 and was expected to provide an adequate voltage stability margin.

Although Option 2 did not meet the system reliability criteria for the Potential Load scenario, there are a number of different expansion options that can augment the load serving capability of Option 2 as the outlook for greater load and generation resources in this region becomes more certain. More specifically, as indicated by these studies, Option 3 or 4 are two possible options that could be constructed from Option 2 to meet applicable transmission planning criteria while serving significantly higher loads in this region. Option 2 also aligns with the long-term needs identified for the area in the 2016 Long-Term System Assessment.

Table 9.1 Options Comparison

Description	Option 1	Option 2	Option 3	Option 4
System Performance – Study Case	Met criteria	Met criteria	Met criteria	Met criteria
System Performance – Potential Load Case	Criteria not Met	Criteria not	Met criteria	Met criteria
Capital cost ($ Million)	464	336	446	501
PV Results Culberson Load Served (MW)	917	717	917	1037
Relative Production Cost Savings ($ Million)	-	6.2	6.6	6.6
Total System Loss Reduction (MW)	10.4	31.2	34.4	34.4
New Right of Way Required (Miles)	187	169	235	235

Additional studies were performed to verify that Option 2 will provide the most cost-effective configuration to meet the Study Case load conditions consistent with ERCOT Protocol and Planning Guide requirements.

9.1. Final Steady-State Performance Test

NERC P3, P6-1, P6-2 and P6-3 contingency analyses were performed under the Study Case load conditions with Option 2. This Option had no voltage collapse for these contingencies at the Study Case load level with both base case generation and with No Solar conditions applied.

Additionally, P2.2-2.3 (EHV), P4.1-P4.5 (EHV) and P5 (EHV) contingencies for the West and Far West Weather Zones were applied to Option 2 using the Study Case load levels with the base case generation and with No Solar conditions applied. There were no criteria violations found for Option 2 based on the conditions studied.

Figure 9.1 shows Option 2 applied to the study area.

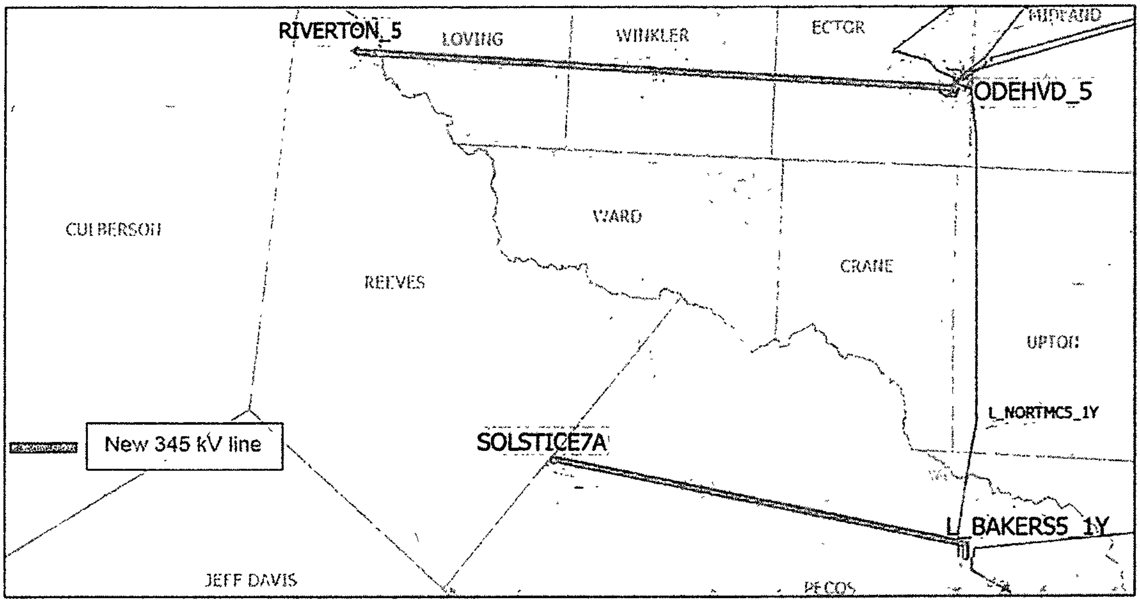


Figure 9.1: Option 2 applied to the Study area

9.2. Dynamic Performance

The majority of the loads in the study area were assumed to be oil and gas customers who employ voltage sensitive electric equipment in their operations. As indicated by the TSPs, heavy motor load was assumed to represent the load characteristic in the study area. The preferred Option 2 was tested using time domain dynamic stability simulations including a dynamic load model to quantify system stability.

It was assumed that if simulations indicated an acceptable (stable) system response following severe events and/or three-phase faults, the stability response would also be acceptable for the same events with single-line-to-ground (SLG) fault. If a potential stability issue was observed, the simulation was rerun with SLG faults to ensure a stable system response following a NERC planning events when applicable, thereby demonstrating compliance with NERC planning standards and ERCOT reliability criteria. Selected ERCOT transmission buses were monitored for frequency and voltage deviations. Nearby synchronous generating units were monitored for angular separation.

The limiting events identified in the PV analysis were studied in the dynamic simulation.

The dynamic event definitions included the removal of all elements that the protection system and other automatic controls are expected to disconnect for each event.

The dynamic simulation results showed that with Option 2 upgrades implemented the area of concern met the NERC and ERCOT reliability criteria. Detailed dynamic simulation results are presented in the Appendix.

10. Sensitivity Studies

Sensitivity studies were performed to ensure compliance with Planning Guide requirements.

10.1. Generation Sensitivity Analysis

ERCOT performed a generation sensitivity analysis based on Planning Guide Section 3.1.3(4) (a). Generator additions with signed Interconnection Agreements but that did not meet Planning Guide Section 6.9 conditions for inclusion in the base cases at the beginning of the study in the study region were added to the Study Case (based on the 2017 March Generator Interconnection Status report). In between the October 2016 Generator Interconnection Status and March 2017 Generator Interconnection Status reports there were another five units that met Planning Guide Section 6.9 conditions. These units were also added in this sensitivity study. Table 10.1.1 and 10.1.2 show all the generators that were added to the Study Case for this analysis.

Table 10.1.1 Generators Met Planning Guide Section 6.9 Conditions (2017 March GIS report)

GINR Number	Project Name	MW	Fuel	County	Weather Zone
14INR0044	West of Pecos Solar	100	Solar	Reeves	Far West
15INR0064	BearKat Wind A	197	Wind	Glasscock	Far West
17INR0027	Dermott Wind 1	250	Wind	Scurry	West
15INR0064b	BearKat Wind B	163	Wind	Glasscock	Far West
17INR0027b	Coyote Wind	250	Wind	Scurry	West

Table 10.1.2 Generators with SGIA That Did Not Meet Planning Guide Section 6.9 Conditions (2017 March GIS report)

GINR Number	Project Name	MW	Fuel	County	Weather Zone
13INR0023	Texas Clean C	240	Coal	Ector	Far West
16INR0010	FGE Texas 1	745	Gas	Mitchell	West
17INR0010	FGE Texas II	799	Gas	Mitchell	West
12INR0059c	Barilla Solar 2	21	Solar	Pecos	Far West
16INR0019	Capricorn Ridge Solar	100	Solar	Coke	West
16INR0023b	Lamesa Solar B (Phase II)	98	Solar	Dawson	Far West
12INR0060	Infinity Live Oak Wind	201	Wind	Schleicher	West
16INR0086	Cactus Flats Wind	150	Wind	Concho	West
13INR0020b	Rattlesnake W2	158	Wind	Glasscock	Far West

The purpose of this generation sensitivity analysis was to evaluate the effect of the above mentioned generation units on the recommended transmission project. It was found that the Study Case violations did not entirely disappear with these additional generations. The violations seen for the Study Case with the generation units meeting Planning Guide Section 3.1.3(4) (a) criteria are summarized in Tables 10.2.1 – 10.2.4.

Table 10.2.1 Thermal Overloading in the Study Region under N-1 Conditions, With Generation meeting Planning Guide Section 3.1.3(4) (a)

Element	Length (miles)	Study Case	No Solar
16th Street TNP to Woodward2 138 kV ckt 1	31.8	No Violation	110%
Rio Pecos to Woodward2 138 kV ckt 1	1.9	No Violation	101%
Tombstone to Woodward1 Tap 138 kV ckt 1	15.7	No Violation	101%

Table 10.2.2 Unsolvable contingencies, With Generation meeting Planning Guide Section 3.1.3(4) (a)

#	Contingency (Category)	Study Case	No Solar
1	CEII	Unsolvable	Unsolvable

Table 10.2.3 Voltage Deviations in the Study Region under N-1 Conditions, With Generation meeting Planning Guide Section 3.1.3(4) (a)

Bus	Nominal Voltage (KV)	Study Case	No Solar
Wolfbone Tap TNP	138	< 8%	8.8%
Woodward 1 Tap	138	< 8%	8.7%
Woodward 1	138	< 8%	8.7%

•

Table 10.2.4 Voltage Violations in the Study Region under N-1 Conditions, With Generation meeting Planning Guide Section 3.1.3(4) (a)

Bus	Nominal Voltage (KV)	Study Case	No Solar
Sandlake	138	0.898	No Violation
Coalsndr	138	0 888	No Violation
Mentone SW	138	0.882	No Violation
Culberson2	138	0.881	No Violation
Screwbean Tap	138	0.878	No Violation
Kunitz	138	0.877	No Violation
Salt Creek West Poi	138	0.877	No Violation
Culberson Wind Farm	138	0.876	No Violation
Culberson	138	0.876	No Violation
Black River	138	0.871	0.899
Orla Southwest Poi	138	0.869	0.892
Riverton	138	0.869	0.896
Sand Bend Poi	138	0.867	0.895
Orla Plant	138	0.867	0.889
Salt Creek South Poi	138	0.864	0.892
Oxy Century TNP	138	No Violation	0.898
Wink TNP	138	No Violation	0 897

The above tables demonstrate the need for the transmission upgrades required to meet the NERC and ERCOT reliability criteria even with the additional generators in Tables 10.1.1 and 10.1.2. Full contingency results can be found in the Appendix.

Further analysis was performed testing these new sensitivity cases with Option 2 improvements applied. There were no criteria violations (under NERC P1, P2-1 and P7 events) seen for Option 2 with the generation sensitivity discussed in this section.

10.2. Load Scaling Impact Analysis

Planning Guide Section 3.1.3(4) (b) requires evaluation of the impact of various load scaling on the criteria violations seen in the study cases. As stated in Section 3.1.1, ERCOT used the 2021 West/Far West (WFW) summer peak case from the 2016 RTP for the steady state analysis. This case was created in accordance with the 2016 Regional Transmission Plan Study Scope and Process document[3], which included load scaled down from the respective non-coincident peaks forecasted in the North, North Central, East, Coast, South, and South Central Weather Zones.

There were four 138 kV thermal violations seen in the steady state analysis as described in Section 4.1 of this report. Power Transfer Distribution Factors (PTDFs) were calculated using PowerWorld Simulator for these four lines using the Far West Weather Zone as the sink, and each of the other seven weather zones individually as the sources. It was found that no matter which other zones were scaled, the PTDFs for each of the lines remained very close. Therefore, ERCOT concluded that the load scaling applied in the cases did not affect the study results. The Appendix contains the PTDFs for each of the four lines under various transfers.

Because the voltage violations were observed at load serving buses, ERCOT assumed that the load scaling in the outside weather zones did not have a material impact on the observed need.

The case used in the dynamic stability portion of the analysis did not contain load scaling, therefore, the observed criteria violations were not affected by load scaling.

[3] http://www.ercot.com/content/wcm/key_documents_lists/77730/2016_RTP_Scope_Process_v1.3_clean.pdf

11. Conclusion

Based on the forecasted loads and scenarios analyzed, ERCOT determined that there is a reliability need to improve the transmission system in Far West Texas. After consideration of the project alternatives, ERCOT concluded that the upgrades identified in Option 2 meet the reliability criteria in the most cost effective manner and have multiple expansion paths to accommodate future load growth in the area of study. Option 2 is estimated to cost $336 million and is described as follows:

- Expand the Riverton Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformer.
- Construct a new approximately 85-mile 345 kV line on double-circuit structures with one circuit in place, between Moss and Riverton Switch Station. Add a second circuit to the existing 16-mile Moss Switch Station – Odessa EHV 345 kV double-circuit structures. Install 345 kV circuit breaker(s) at Odessa EHV Switch Station. Connect the new circuit from Riverton Switch Station and terminate at Odessa EHV Switch Station to create the new Odessa EHV – Riverton 345 kV Line.
- Expand the Solstice Switch Station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformer.
- Construct a new approximately 68-mile 345 kV line from Solstice Switch Station to Bakersfield Station on double-circuit structures with one circuit in place.

12. Designated Provider of Transmission Facilities

In accordance with the ERCOT Nodal Protocols Section 3.11.4.8, ERCOT staff is to designate transmission providers for projects reviewed in the RPG. The default providers will be those that own the end points of the new projects. These providers can agree to provide or delegate the new facilities or inform ERCOT if they do not elect to provide them. If different providers own the two ends of the recommended projects, ERCOT will designate them as co-providers and they can decide between themselves what parts of the recommended projects they will each provide.

Oncor owns the Odessa EHV Switch Station and the planned Riverton Switch Station. Therefore, ERCOT designates Oncor as the designated provider for the 345 kV Odessa EHV Switch Station to Riverton Switch Station transmission facilities along with the two recommended 345/138 kV autotransformers at Riverton Switch Station.

LCRA TSC owns the Bakersfield Station and AEP Texas owns the Solstice Switch Station. Therefore, ERCOT designates AEP Texas and LCRA TSC as the designated co-providers for the 345 kV Bakersfield Station to Solstice Switch Station transmission facilities along with the two recommended 345/138 kV autotransformers at Solstice Switch Station.

13. Appendix

13.1.	Base Case Violations – Steady State	BaseCaseViolations.xlsx
13.2.	Options Diagrams	Options_Diagrams.pptx
13.3.	Steady State Violations of Project Options	ProjectOptionsViolations.xlsx
13.4.	Violations – Generation Sensitivity Analysis	GenerationSensitivityAnalysisViolations
13.5.	Dynamic Analysis Results	CEII

Far West Texas Project 2

ERCOT REGIONAL PLANNING GROUP SUBMITTAL

Feb 01, 2018

ASSETS PLANNING
DISTRIBUTION AND TRANSMISSION
BUSINESS AND OPERATIONS SERVICES

ONCOR®

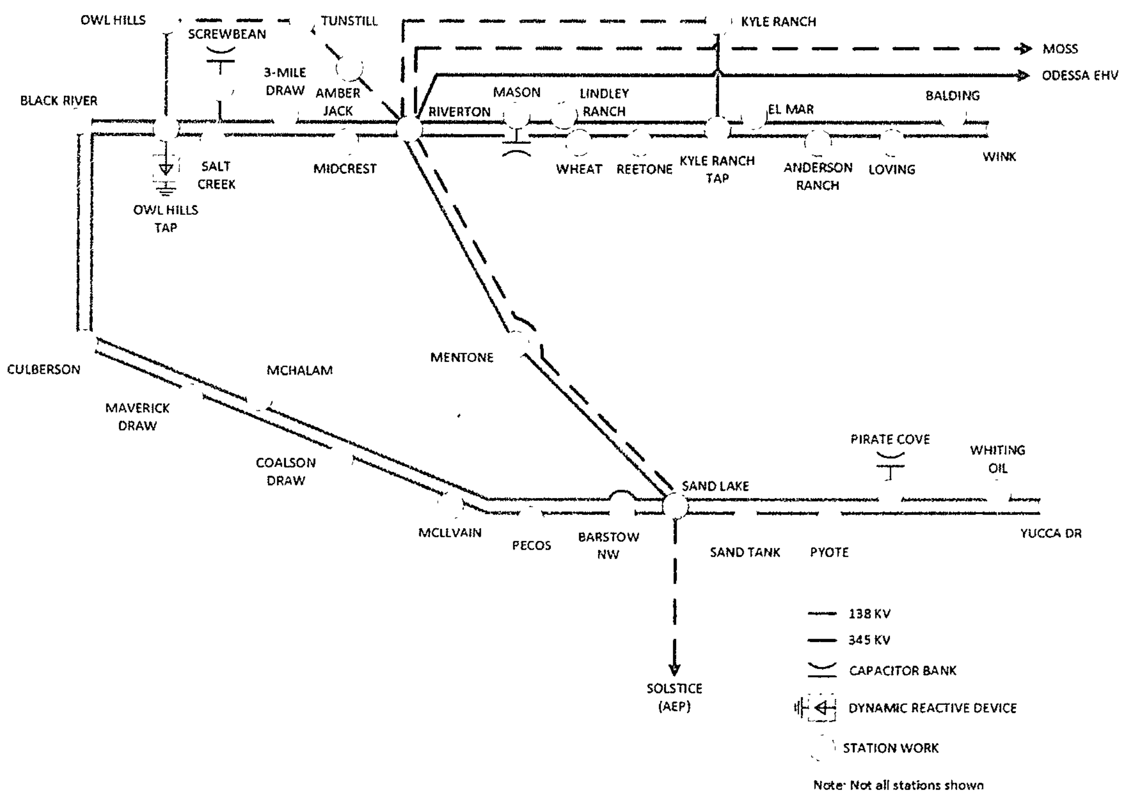
ATTACHMENT NO. 8

Table of Contents

Executive Summary

Oncor proposes to construct the Far West Texas Project 2, a Far West Zone transmission project consisting of the following elements:

- Construct a new approximately 40-mile 345 kV line on double-circuit structures with one circuit in place from Sand Lake Sw. Sta. to Solstice Sw. Sta. Oncor will build half the line from Sand Lake and AEP will build half the line from Solstice.
- Sand Lake 345 kV Sw. Sta. additions including two 600 MVA, 345/138 kV autotransformers.
- Install the second circuit on the Riverton –Sand Lake 345 kV Line structures. Connect the new circuit from Riverton 345 kV Sw. Sta.to Sand Lake 345 kV Sw. Sta. to create the new Riverton – Sand Lake 345 kV Line.
- Install the second 345 kV circuit on the Odessa EHV – Riverton 345 kV Line structures (Moss – Riverton 345 kV Line)
- Construct the new Kyle Ranch Tap 138 kV Sw. Sta. in the Wink – Riverton double-circuit 138 kV Line
- Construct a new approximately 20-mile 138 kV line on double-circuit structures with one circuit in place from Kyle Ranch 138 kV Substation to Riverton 138 kV Sw. Sta.
- Construct a new approximately 20-mile 138 kV line on double circuit structures with one circuit in place from Owl Hills 138 kV Substation to Riverton 138 kV Sw. Sta.



This $194 million Tier-1 project in Reeves, Loving, and Pecos counties is recommended for construction to meet a Summer 2023 in-service date. This projected date may change based on requirements surrounding timing for environmental assessment, certification/licensing request and regulatory approval, land/rights-of-way acquisition, or other project related requirements. The need date may also be sooner based on the timing of new load additions in the area.

In June 2017, the ERCOT Board of Directors approved a portion of the Far West Texas Project, which included construction of two new 345 kV lines and autotransformer additions. In ERCOT's independent review of the project, ERCOT indicated that the approved project could serve up to 717 MW along the Oncor Wink – Culberson Yucca Drive – Culberson 138 kV transmission lines (The Culberson Loop) before other transmission system improvements would be required. ERCOT also identified future augmentations to the approved project that could serve up to 1037 MW.

Oncor has contractually confirmed load additions of 1013 MW that surpass ERCOT's indicated 717 MW limit for the approved Far West Texas Project. Additionally, known potential load additions may bring the total to 1339 MW. With these additions of load, expansion of the approved Far West Texas Project is needed to address reliability requirements and ensure the transmission system in the area is able to meet this load demand.

The Far West Texas Project 2 will complete the 345 kV loop between Riverton and Solstice, providing additional injection points into Oncor's Wink – Culberson - Yucca Drive 138 kV transmission lines (The Culberson Loop). The project will also add new network connections that will increase reliability, provide additional load serving capacity, support voltage conditions, enable clearances, and increase operational flexibility.

Introduction

This report describes the need to construct the Far West Texas Project 2 in Loving, Reeves, and Pecos counties.

In June 2017, the Electric Reliability Council of Texas (ERCOT) Board of Directors approved a portion of the Far West Texas Project, a Tier 1 transmission project to address several unacceptable voltage and transmission facility loading conditions on Oncor and American Electric Power (AEP) facilities in the far west region. ERCOT's analysis of the project reviewed immediate system needs based on existing loads and loads with signed Facility Extension Agreements (FEAs). As such the approved project elements were a subset of the proposed Far West Texas Project and included the new radial Odessa EHV – Riverton 345 kV Line, the new radial Bakersfield – Solstice 345 kV Line, two 345/138 kV autotransformers at Riverton, and two 345/138 kV autotransformers at Solstice.

In the independent review for the Far West Texas Project, ERCOT performed voltage stability analysis which indicated that the maximum load serving capability for the approved project was 717 MW along Oncor's Wink – Culberson 138 kV Line and the Yucca Drive – Culberson 138 kV Line, referred to as The Culberson Loop. ERCOT also indicated future expansion options for the Far West Texas Project to increase the load serving capacity up to 1037 MW. Expansion options included the need to connect the two radial 345 kV lines and install a Synchronous Condenser.

Oncor has continued to see large load growth along these transmission lines due to expansion of the oil and natural gas industry and recently submitted the Far West Texas Dynamic Reactive Devices (DRD) Project in December 2017 to address near term load increases in the 2019 timeframe. Additional large requests for electric service along these lines have been received, which will require expansion of the Far West Texas Project elements approved in 2017, including connection of the radial Odessa EVH – Riverton and Bakersfield – Solstice 345 kV Lines.

Purpose and Necessity

Load Growth

Oncor has continued to see load growth in the Delaware Basin served by Oncor's existing Wink – Culberson 138 kV Line and the Yucca Drive – Culberson 138 kV Line, referred to as The Culberson Loop. Since the RPG approval of the Oncor/AEP Far West Texas Project in May 2017, Oncor has continued to receive numerous new load additions from HV customers, many of which have requested in-service for their facilities beginning in the year 2018. As a result, Oncor recently submitted the Far West Texas DRD Project submittal, in which confirmed load service requests had reached 790 MW by 2022.

The immediate urgency for the Far West DRD Project is driven by needs to address operational and reliability issues before the new 345 kV lines can be built. Further long-term improvements for the region are still needed as the net load in The Culberson Loop continues to grow beyond the current capacity. Both during and after Oncor completed its Far West Texas DRD Project studies, Oncor has continued to see new contracted loads that will increase the total peak load served in The Culberson Loop to 1013 MW.

Table 1 below shows the confirmed load requests and the total projected non-coincident summer peak loads for The Culberson Loop. The values shown under Confirmed Load Requests includes only confirmed additions through the ERCOT 2017 Annual Load Data Request (ALDR) process and high voltage (HV) customers with contractually signed obligations. This data alone, however, provides an incomplete picture of the future load in this area because it fails to consider future load growth beyond what is contractually committed at the moment of study. In addition to new customers that have signed agreements, there are a number of new load additions in discussion that could potentially add approximately 300 MW of load to The Culberson loop beyond the load totals described above. The Total Projected Load Additions shown in Table 1 include pending additions that are in the study and contractual discussion stages between Oncor and customers, and have a probable likelihood of bringing the total load served in the loop to 1339 MW by 2023.

	Confirmed Load Requests					
	2017	**2018**	**2019**	**2020**	**2021**	**2022**
Total (MW)	**300.6**	**580.2**	**775.4**	**893.0**	**964.4**	**1013.1**
	Total Projected Load Additions					
Total (MW)	**300.6**	**670.3**	**983.8**	**1163.4**	**1292.0**	**1339.8**

Table 1- Total Projected Load (MW) Served from The Culberson Loop

Table 2 below shows a timeline of how the total Oncor load forecast for The Culberson Loop has changed over the last few years. The Total Load Forecast column shows what the total confirmed load projection was at the particular time shown in the Forecast Date column. The Timing Description column shows what RPG project was in progress at that same particular time.

Forecast Date	Total Load Forecast	Timing Description
02/2013	148 MW	Permian – Culberson Submittal
02/2016	252 MW	Riverton – Sand Lake Submittal
04/2016	425 MW	Far West TX Project Submittal
05/2017	596 MW	Far West TX Project Approval
10/2017	790 MW	Far West DRD Project Submittal
01/2018	1013 MW	Far West TX Project 2 Submittal
01/2018	1339 MW (w/load under discussion but unsigned)	Far West TX Project 2 Submittal

Table 2- Projected Load (MW) Served from The Culberson Loop Timeline

This table illustrates the rapid new load requests this area of the ERCOT system has received in a relatively short time frame and the need for system planning in this area to extend beyond contractually committed loads. The speed of growth at which many of these customers are coming online makes it difficult to construct and operate facilities to adequately serve the load in a timely fashion, makes accurately studying this area of the ERCOT system difficult, and results in plans that are potentially insufficient shortly after they are created. Restricting planning to the contractually committed load forecast for projects in this area provides no margin of error for this rapid growth.

For example when Oncor submitted the original Far West Texas Project to RPG in 2016, the forecast at that time for 2021 was 425 MW. Today Oncor forecasts that its 2018 peak load for this area will be 580 MW. Another good example of this dramatically increasing load growth is the load additions that occurred during the course of Oncor's preparation of the DRD project submittal. During Oncor's studies, the ultimate totals for The Culberson Loop increased from 790 MW to 1013 MW in the span of a few months. In addition, the total load forecast for The Culberson Loop already exceeds ERCOT's expected load serving capability for the approved Far West Texas Project (717 MW), well before CCN applications can even be filed with the Public Utility Commission for the new 345 kV lines.

Based on this recent history, it is reasonable to expect that the total net load may increase throughout the RPG review process and will be higher upon completion of ERCOT's independent review. Planning beyond the signed contractual numbers is paramount for this area of the ERCOT grid which is seeing rapidly increasing load growth. As a result, Oncor recommends planning studies be performed beyond the contracted total load of 1013 MW and to the potential load of 1339 MW.

Base Case Analysis

In the original Far West Texas Project April 2016 submittal, Oncor identified numerous contingencies that resulted in unacceptable voltage conditions. Studies showed that in 2021, multiple P6 and P7 branch outages would result in unsolved contingencies during load flow analysis. ERCOT saw similar issues and performed sensitivity studies on the area as part of the RPG review process. ERCOT's independent review determined that as load grows in the area, further improvements to the approved Far West Texas Project would be needed. Ultimately ERCOT indicated that closing the 345 kV loop between Riverton, Sandlake, and Solstice would be needed if load reached 917 MW and the addition of a dynamic reactive device (DRD) such as a Synchronous Condenser would be needed if load reached 1037 MW.

The current confirmed and future potential forecast of 1013 MW and 1339 MW exceed ERCOT's original study thresholds. Due to the near term load increases in the 2018-2020 timeframe before the Odessa EHV – Riverton 345 kV Line can be built, Oncor recommended the acceleration of the reactive compensation piece of ERCOT's original Far West Texas Project recommendations with the Far West DRD Project.

With the new updated load totals, Oncor performed studies using the ERCOT Steady State Working Group (SSWG) 2023SUM case published in October 2017 and the ERCOT Dynamics Working Group (DWG) 2023SP case published in Spring 2017 as the base cases. Table 3 below shows a summary of the adjustments that were made to the cases for simulations in the updated study.

Case Adjustment	Description
Outage of West of Pecos Solar Generation	Outage of solar generation to simulate night time conditions.
Outage of Permian Basin SES Generation	Permian Basin is normally fully dispatched in the ERCOT Regional Transmission Plan (RTP) base cases as well as the Steady State Working Group (SSWG) base cases. However in real-time

	operations, Permian Basin is not normally running and is not intended to be a 24/7 continuous operating generator. As a result, Permian Basin generation being offline is a reasonable scenario and a variation that would more closely mimic real-time operations. The results of studies in this area demonstrate worse operating conditions when the Permian Basin Plant generation is unavailable, and should be considered in analysis.
Updates for confirmed load additions (Total 1013 MW)	New HV points-of-delivery (PODs) and existing substation load updates were made per the MW values shown in Table 1 within The Culberson Loop. Load point changes can be found in the project file submissions.
Updates for potential load additions (Additional 326 MW)	New HV points-of-delivery (PODs) were added based on the expected connection locations and load projections provided by customers currently in the contractual discussion process. These customers and their data are considered private and confidential.
Addition of the Far West Texas DRD Project	Two 250 MVAR, 138 kV STATCOMs at Owl Hills Tap Sw. Sta. Please see Oncor's Far West Texas DRD RPG Submittal from December 2017 for details.

Table 3- Base Case Adjustments

Oncor studies show that even with the approved Far West Texas Project and dynamic reactive devices in place, the increased load additions will result in additional violations of the NERC standard TPL-001-04 reliability criteria. Steady state contingency analysis for the 2023 base case shows that loss of the radial Odessa EHV – Riverton 345 kV Line, a NERC category P1.2 contingency, results in multiple voltage violations along The Culberson Loop. Figure 1 below shows the voltage response of buses along The Culberson Loop when opening this line without a fault, while Figure 2 below shows the single circuit outage without a fault.

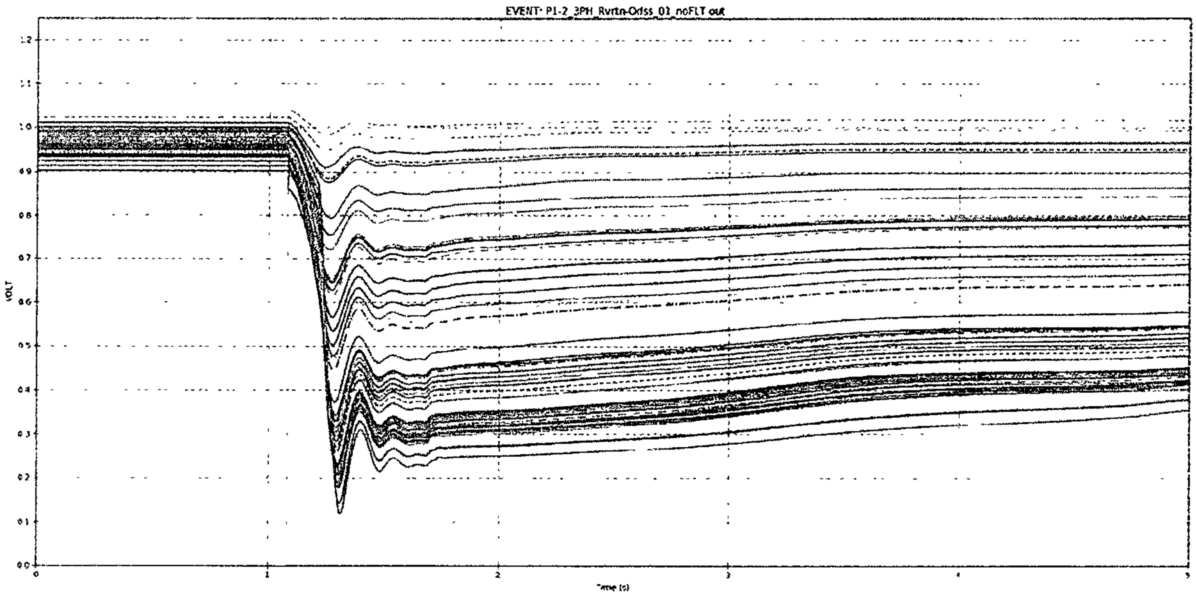


Figure 1 – Loss of Odessa EHV – Riverton 345 kV Line Voltage Response (No Fault)

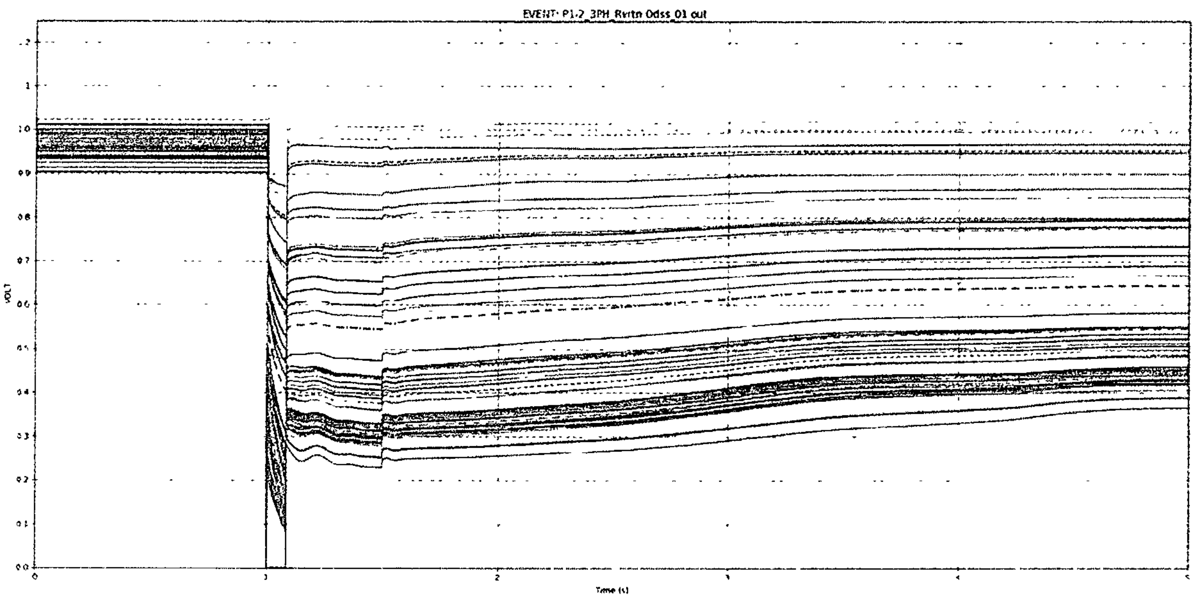


Figure 2 – Loss of Odessa EHV – Riverton 345 kV Line Voltage Response (With Fault)

The result indicates that a single-line outage of the radial 345 kV transmission line will result in a service interruption to all customers served within The Culberson Loop (1013 MWs of load in 2022). This analysis also indicates that taking a clearance on the radial 345 kV line will be problematic. As a result, there is an urgent need to close the loop and create an alternative transmission feed for the 345 kV source at Riverton when the load reaches the 1013 MW level. Creating this bi-directional feed would address these criteria violations and increase operational flexibility of the radial 345 kV line. It should be noted that this need date may be sooner, potentially as soon as 2020, based on potential load additions that are currently in contractual discussion as shown in Table 1.

Steady state contingency analysis for the 2023 base case identified additional category P1.2 and P7.1 contingencies that resulted in voltage violations under NERC Standard TPL-001-4 reliability criteria. There are six (6) different contingencies that result in the remaining line sections of The Culberson Loop to be insufficient to maintain adequate system operating conditions, resulting in an unsolved power flow. In addition, there are fifteen (15) different contingencies that result in multiple buses in The Culberson Loop being below acceptable voltage limits.

These studies show that multiple contingencies result in buses along The Culberson Loop being unable to recover to acceptable voltage levels as defined in the ERCOT Planning Guide Section 4.1.1.4. Acceptable voltage limits are defined as 0.90 per unit to 1.05 per unit in the post-contingency state following the occurrence of any operating condition in categories P1 through P7. These scenarios would ultimately result in loss of service to these customers.

Figure 3 below shows the same voltage response after loss of the Odessa EHV – Riverton 345 kV Line at the confirmed 1339 MW load level with the 345 kV loop closed. While voltage levels are able to eventually recover to acceptable levels post-contingency, there is some uncertainty as seen in the fluctuations prior to recovery. This particular simulation assumed that 10% of customer motors included voltage protection set to trip if their respective bus voltages were below 0.80 PU for 30 cycles. The abrupt vertical change in the plot at about 1.5 seconds indicates that many customer motors did trip on voltage protection during the simulation.

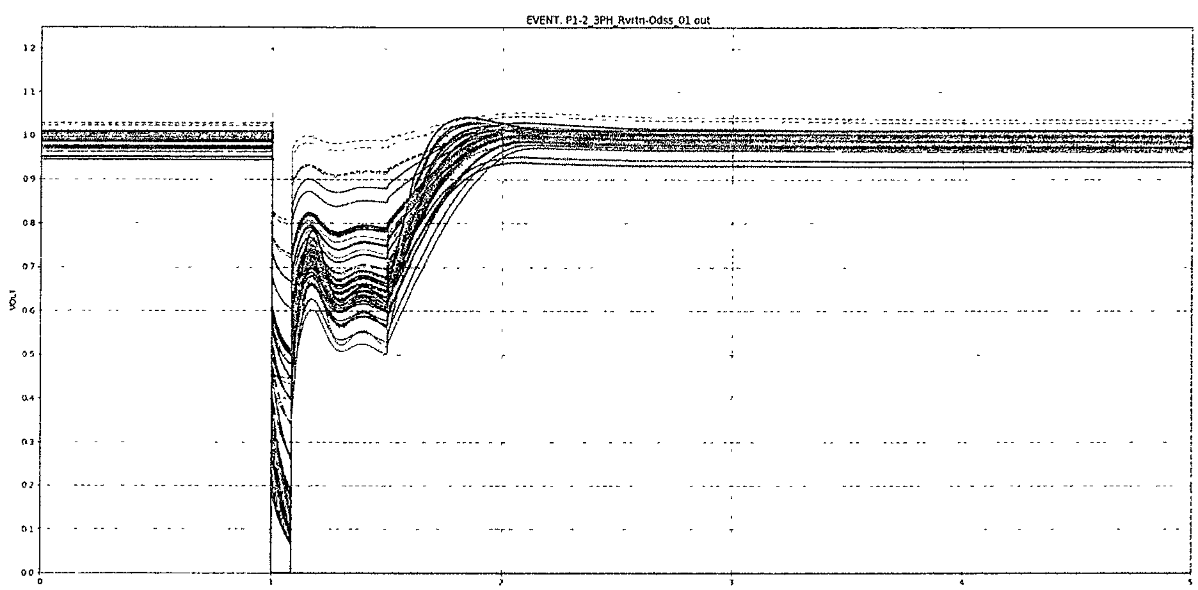


Figure 5 – Dynamic Voltage Response of The Culberson Loop for P1.2 (Odessa EHV – Riverton 345 kV Line)

Uncertainties in customer's motor behavior and protection create unknowns in the study results since estimations must be made for the dynamic load models. Majority of the loads served within The Culberson Loop are oil and gas customers who employ voltage sensitive electric equipment and motors in their operations, and have varying operational practices and philosophies on protection of their equipment. This increases the need for some margin to be provided in the proposed solution beyond the contracted load amount. Otherwise, the reliability of the transmission grid in the area could be dependent on customer owned protection and customers tripping their load. Furthermore, there is no indication that the system would support reconnection of customer load during this compromised condition.

Operational Concerns

Oncor currently has remedial operational schemes in place to mitigate post-contingency voltage violations in the area until additional facilities can be built to reliably serve the increasing load. Additional operation schemes will be needed as load within The Culberson Loop continues to grow. This may include various low voltage load shed schemes, transfer trip schemes, and load restoration procedures. In some instances, these measures will prevent the ability to reclose after a system event and prohibit eventual restoration of customers' electricity service. They may also limit operational flexibility in switching out failed equipment and restoring loads radially, putting potentially hundreds of megawatts at risk depending on the outage scenario.

As shown above in studies, taking an outage of the radial Odessa EHV – Riverton 345 kV Line may be problematic due to the reliance on the circuit for reliability of the area. This will only make an already difficult area to operate more difficult since this area of the transmission system has limited amount of transmission infrastructure. As load grows in the area, this system will become heavily reliant on the lone 345 kV source.

Table 4 shows a comparison matrix of the various stages of The Culberson Loop transmission system. Many contingencies result in significant consequential load loss. In addition, Under Voltage Load Shed (UVLS) will be required to restore the system to acceptable voltage levels. Since there are currently no mitigation alternatives to UVLS for restoring system voltage within The Culberson Loop, the out-of-service load will remain without power until the initiating problem can be corrected.

Year/Season	Load Level (MW)	Outage	NERC Category	Consequential Load Loss (MW)	Minimum UVLS (MW)	Max Load at Risk (MW)	Max Load at Risk (Percent of Total)
2018 Spring	470	Specific contingency definitions redacted for security purposes.	P7	169	65	234	50%
			P7	164			
			P7	114			
			P1	105			
2018 Fall	521		P7	190	70	260	50%
			P7	173			
			P7	120			
			P1	108			
2019 Spring	647		P7	217	75	292	45%
			P1	112			
			P1	105			
2019 Fall	655		P7	223	75	298	45%
			P7	150			
			P1	116			
			P1	107			
2022 Fall	1013		P7	441	75	516	51%
			P1	295			
			P7	152			
			P1	146			
			P7	127			
			P1	103			

Table 4 – Potential Loss of Load

As the system topology changes and more load is connected, these temporary operational measures will likely remain in place to provide margin and mitigate unresolved issues until projects are constructed. It should be noted that with the large number of new HV customers being connected to these lines over the next couple years, there will be a significant number of planned outages along The Culberson Loop, further adding to the complexity of operating the system in this area and consistently placing these lines in an N-1 state. As a result, this area of the system will present multiple operational challenges until appropriate facilities such as the Far West DRD Project and the future 345 kV infrastructure are built. While these temporary solutions are not project alternatives, they will be needed since studies show that, without these solutions in place, the system cannot maintain post-contingency system voltage in accordance with NERC TPL-001-4 requirements.

Project Description

The original Far West Texas Project RPG submittal in 2016 included a full 345 kV loop between Odessa EHV, Moss, Riverton, Sand Lake, Solstice, and Bakersfield. In addition, it included provisions for future load growth by enabling the installation of new autotransformers at stations along the proposed 345 kV transmission lines. This proposed project would complete the original proposed project by closing the 345 kV loop and installing additional autotransformers to mitigate the previously discussed violations. In addition, new 138 kV network connections are recommended to provide additional voltage support and load serving margin.

The proposed project estimated cost is $194 million and consists of the following elements:

- Construct a new approximately 40-mile 345 kV line on double-circuit structures with one circuit in place from Sand Lake Sw. Sta.to Solstice Sw. Sta. Oncor will build half the line from Sand Lake and AEP will build half the line from Solstice.
- Expand the Sand Lake Sw. Sta. to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers.
- Install the second circuit on the Riverton –Sand Lake 345 kV Line structures. Connect the new circuit from Riverton 345 kV Sw. Sta.to Sand Lake 345 kV Sw. Sta. to create the new Riverton – Sand Lake 345 kV Line.
- Install the second 345 kV circuit on the Odessa EHV – Riverton 345 kV Line structures (Moss – Riverton 345 kV Line)
- Construct the new Kyle Ranch Tap 138 kV Sw. Sta. in the Wink – Riverton double-circuit 138 kV Line
- Construct a new approximately 20-mile 138 kV line on double-circuit structures with one circuit in place from Kyle Ranch 138 kV Substation to Riverton 138 kV Sw. Sta.
- Construct a new approximately 20-mile 138 kV line on double circuit structures with one circuit in place from Owl Hills 138 kV Substation to Riverton 138 kV Sw. Sta.

Second 345 kV Circuit

As shown in the studies, outage of the radial Odessa EHV – Riverton 345 kV Line will be prohibitive. As a result, addition of the 2nd circuit to the approved Odessa EHV – Riverton 345 kV Line was considered and would thus address the single circuit outage concerns. The second circuit would physically share common structures with the Odessa EHV – Riverton 345 kV Line, but would electrically be connected from the Moss 345 kV switching station. Hence the second circuit would be the new Moss – Riverton 345 kV Line, which is estimated to be 85 miles.

The addition of the second 345 kV circuit would address the P1.2 contingency concerns. The voltage response after loss of the Odessa EHV – Riverton 345 kV Line is shown below in Figure 6.

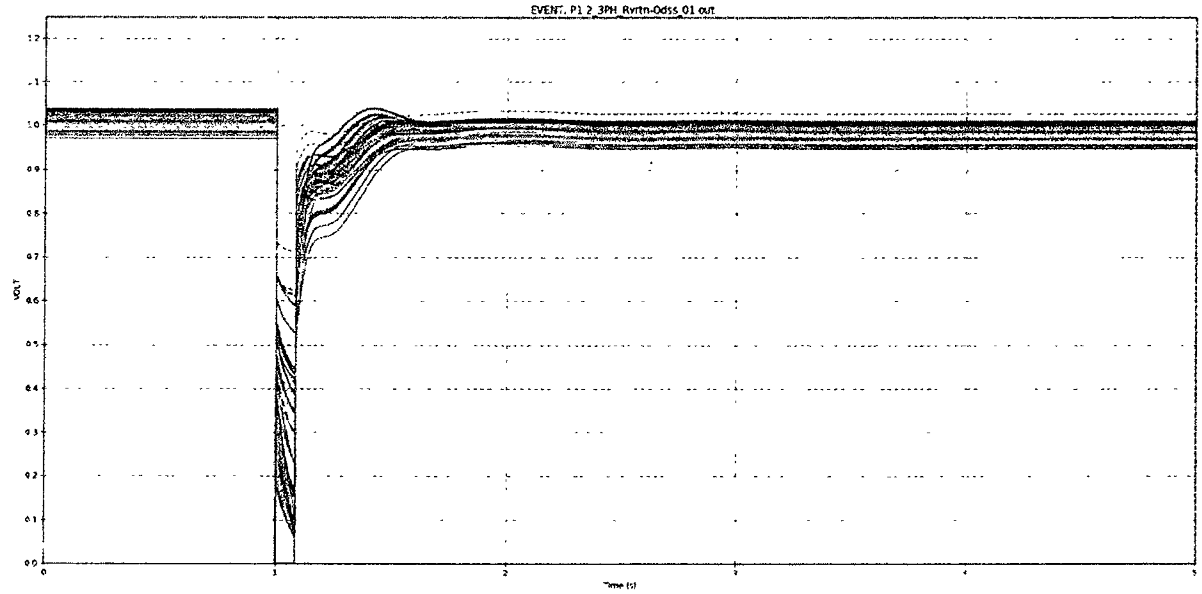


Figure 6 – Dynamic Voltage Response of The Culberson Loop for P1.2 (Odessa EHV – Riverton 345 kV Line)

Constructing the second circuit at the same time as the initial circuit would provide economic cost savings, address the P1.2 contingency, and increase operational flexibility in taking an outage on the single 345 kV circuit. In addition, it takes advantage of mobilized resources during initial construction of the Odessa EHV – Riverton 345 kV Line and avoids the need to return for construction on a newly built transmission facility. Oncor estimates the additional cost to install the second circuit during the construction of the Odessa EHV – Riverton 345 kV Line to be $32m (included in the proposed project estimate). This cost is approximately 50% less than the cost of coming back to install the second circuit at a later time due to reduced access, environmental and mobilization costs in addition to significant construction efficiencies.

New 138 kV Lines

In order to provide transmission facilities necessary to interconnect new customer loads in the area, Oncor has multiple projects to construct new 138 kV lines in the area. Example projects include the Riverton – Sand Lake 138 kV Line, Riverton – Tunstill 138 kV Line, and Orbison Tap – Balding 138 kV Line. With multiple radial taps being extended from the main lines of The Culberson Loop, there are concerns for reliability and operational flexibility, especially with the large size of these loads.

Interconnecting some of these radial lines and converting service from radial to normal looped service would not only address reliability concerns for the radially served loads, but also strengthens the transmission system by creating a more networked system to support voltage conditions and allow operationally flexibility for outages.

Oncor currently has plans to extend radials for the Owl Hills Tap – Owl Hills 138 kV Line and the Kyle Ranch Tap – Kyle Ranch 138 kV Line for new load serving substations within the Delaware Basin. These radial line extensions to serve new loads are Tier 4 Neutral projects in accordance with ERCOT Protocol

Section 3.11.4.4 (e). These new loads were included in the base case analysis with CCN filings planned by Oncor in the near future.

Ultimately, connecting these lines back to another switching station, such as Riverton, will provide such network connections and provide further paths for the future planned 345 kV injection point there.

Oncor studies showed that at the 1339 MW level, these new 138 kV connections could successfully mitigate the voltage violations mentioned previously in addition to the operational and reliability benefits described. This also provides additional transmission infrastructure in areas where little to none exists, and provides infrastructure to establish substations closer to customer's locations in the Delaware Basin.

Diagram

Figure 7 below shows the diagram of the proposed Far West Texas Project 2. The dotted lines depict the transmission line elements and the yellow depicts associated station work of the proposed Far West Texas Project 2.

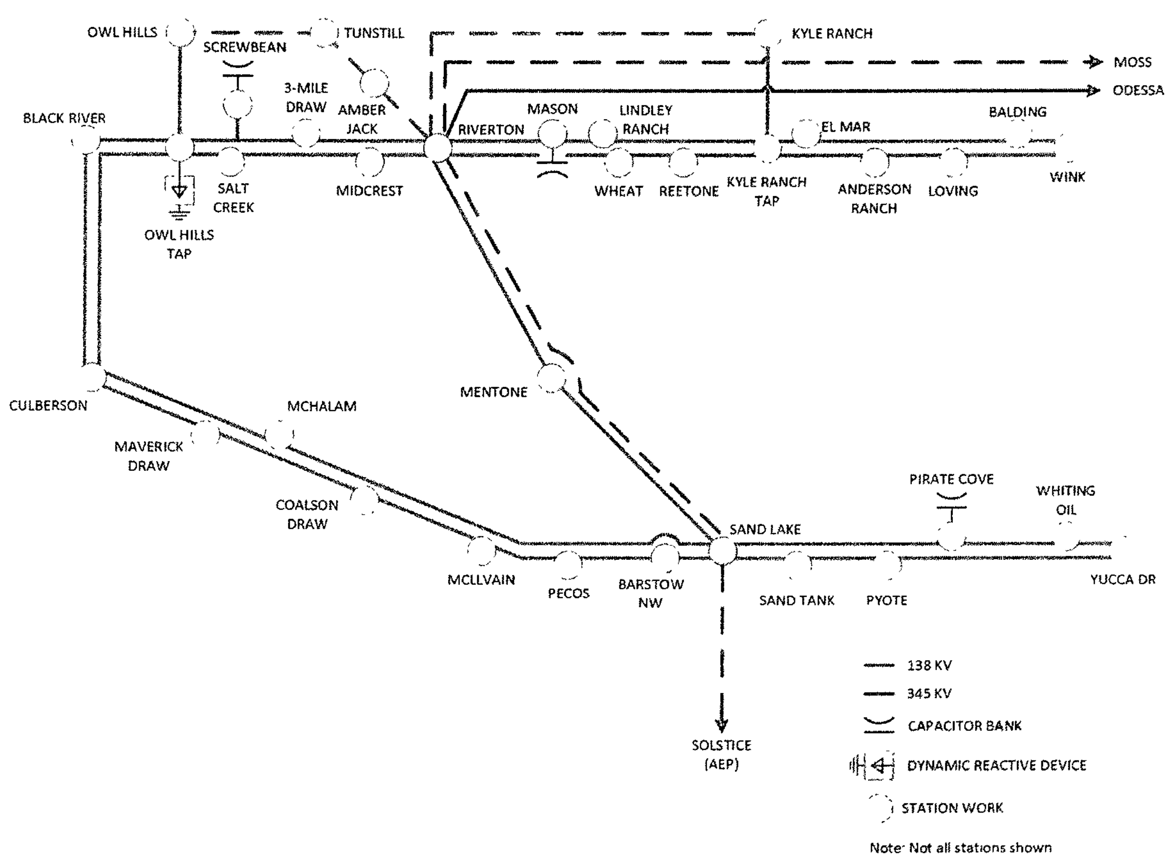


Figure 7 –Diagram

Alternatives

In ERCOT's independent review of the Far West Texas Project, ERCOT reviewed up to 40 different alternatives to the original proposed Far West Texas project. The alternatives included variations of different 138 kV and 345 kV transmission lines and reactive compensation devices.

In its evaluation of the alternatives, ERCOT identified two main options to augment the ultimately approved Far West Texas Project. Both options involved closing the 345 kV loop with added autotransformer capacity at Sand Lake Sw. Sta.

Option 1

- Addition of the 345 kV Line between Riverton – Sand Lake
- Installation of one 345/138 kV autotransformer at Sand Lake
- Construction of new 345 kV Line from Sand Lake to Solstice

Option 2

- Addition of 345 kV Line between Riverton – Sand Lake
- Installation of one 345/138 kV autotransformer at Sand Lake
- Construction of new 345 kV Line from Sand Lake to Solstice
- Installation of 200 MVAR Synchronous Condenser at Culberson

ERCOT's study for the Far West Texas Project indicated that the load serving capacity within the Culberson Loop for Option 1 would be up to 917 MW and for Option 2 up to 1037 MW. In combination with Oncor's recently submitted Far West DRD Project, Oncor's proposed solution closely mirrors ERCOT's recommended Option 2 by closing the 345 kV loop and adding dynamic reactive support.

With the current forecast (1013 MW) approaching the load serving capacity of ERCOT's Option 2 (1037 MW) and the potential 1339 MW load level imminent, additional expansion from the full build out of the Far West Texas Project is needed. As mentioned previously, the need to plan and build facilities beyond the signed contractual numbers is paramount for this area. This is especially important for future 345 kV improvements which need sufficient margin in order to ensure a robust and resilient solution for the area.

Installation of the new Far West Texas DRDs alone will not address new planning criteria violations that result from the increases in load. In addition, the DRDs alone would not close the 345 kV loop, leaving both the Odessa EHV – Riverton and the Bakersfield – Solstice 345 kV lines in radial configurations and susceptible to single outages. As mentioned previously in this report, single contingency loss of the Odessa EHV – Riverton 345 kV line, and the subsequent outage of the two Riverton 345/138 kV autotransformers results in unacceptable voltage conditions in The Culberson Loop.

Another relatively straight forward alternative to augment the existing project is to complete the full 345 kV loop between Odessa EHV – Moss – Riverton – Sand Lake – Solstice – Bakersfield as full double-circuit 345 kV lines. While this would increase operational flexibility and aid the voltage recovery post-contingency, Oncor studies show that this alone would not address individual contingency violations within the Culberson Loop at the 1339 MW level. Oncor steady-state analysis showed that there would still be multiple contingencies that would result in the remaining buses in The Culberson Loop to be below acceptable ranges.

Subsynchronous Resonance Impact

A topology screening assessment was performed to identify new potential Subsynchronous Resonance (SSR) vulnerabilities within the ERCOT system as a result of the proposed project. The assessment revealed that system changes required by the proposed project did not result in any generation resources becoming radial to series capacitors in the event of less than 14 concurrent transmission outages.

Recommendation

Oncor recommends completion of the original 2016 Far West Texas Project by closing the 345 kV loop between Riverton and Solstice and installing autotransformers at Sand Lake. Additionally, Oncor recommends that the second circuit on the Odessa EHV – Riverton 345 kV Line structures be installed at the same time, as well as the addition of two new 138 kV network connections to provide additional voltage support and load serving margin within The Culberson Loop. These projects will effectively mitigate reliability issues, provide transmission infrastructure for future loads to connect, and ensure infrastructure needs are addressed for the Delaware Basin.

Eithar Nashawati
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May 14, 2018

Chad V. Seely
Vice President, General Counsel and Corporate Secretary
Electric Reliability Council of Texas, Inc.
7620 Metro Center Drive
Austin, TX 78744

Dear Mr. Seely:

This letter is a formal request by Oncor Electric Delivery (Oncor), AEP Service Company (AEPSC), and LCRA Transmission Services Corporation (LCRA TSC) for the Electric Reliability Council of Texas (ERCOT) to grant critical designation status for the Riverton – Sand Lake 345 kV Line, Sand Lake – Solstice 345 kV Line, and the Bakersfield – Solstice 345 kV Line projects.

Both the Riverton – Sand Lake and Sand Lake – Solstice 345 kV lines and their associated station work are currently being reviewed by stakeholders and ERCOT through the ERCOT Regional Planning Group (RPG) Project Review Process, as part of The Far West Texas Project 2. Oncor submitted this project to the RPG on Feb 1, 2018. The Bakersfield – Solstice 345 kV Line and its associated station work was previously reviewed by the ERCOT RPG as part of the original Far West Texas Project. The Bakersfield – Solstice 345 kV Line received approval by the ERCOT Technical Advisory Committee (TAC) in May 2017 and by the ERCOT Board of Directors in June 2017.

The original Far West Texas Project as submitted to the RPG on April 20, 2016, proposed, among other things, the new Riverton – Sand Lake and Sand Lake – Solstice 345 kV Lines as part of a new 345 kV transmission loop in Far West Texas. ERCOT did not approve these pieces of the project in its Independent Review of the Far West Texas Project dated May 23, 2017 based on the load projections for the area at the time. At that time, the committed load on the existing Oncor Wink – Culberson Switch 138 kV Line and the Oncor Yucca Drive Switch – Culberson Switch 138 kV Line (together referred to as The Culberson Loop) was expected to be approximately 600 MW by 2022.

In ERCOT's Independent Review of the Far West Texas Project, it indicated that closing the 345 kV loop from the Riverton to Sand Lake to Solstice switching stations would be needed when the load level on The Culberson Loop reached 917 MW, and an additional Dynamic Reactive Device would be needed when that load reached 1037 MW. Since that time, load growth in the area has significantly outpaced the original study projections for the project. As of February 1, 2018, Oncor has contractually committed load requests that will cause the total peak load served by The Culberson Loop to exceed 1000 MW in 2022. With the current forecast fast approaching the load serving thresholds indicated by ERCOT's Independent Review, these scope additions to the original Far West Texas Project are needed as soon as possible.

Recent studies for when The Culberson Loop load reaches over 1000 MW show that the loss of the radial Odessa EHV – Riverton 345 kV Line, a NERC category P1.2 contingency, or the loss of the double circuit Odessa EHV – Riverton 345 kV Line (if a second circuit is approved between Moss and Riverton), a NERC category P7 contingency, result in multiple voltage violations and service interruption to all customers served within The Culberson Loop (1013 MW of load in 2022). This analysis also highlights the impact that taking a clearance on the radial 345 kV line will have on customers since a 345 kV source is critical to maintaining service to customers served on The Culberson Loop.

It should be noted that the load may develop sooner than 2022, potentially as soon as 2020, based on potential load additions that are currently in contractual discussion with Oncor. As of May 1, 2018, the potential load to be served in The Culberson Loop could reach over 1600 MW based on the summation of current customer inquiries. The speed at which many of these customers are coming online has already proved the difficulty to planning, designing, constructing and operating facilities to adequately and reliably serve the load in a timely fashion. The high rate of growth in this area of the ERCOT system makes incremental "wait-and-see" plans for transmission facility improvements insufficient for reliable, "on-time" service to customers.

As a result, in order to continue to provide reliable service to significant load in Far West Texas, there is now a critical need to close the previously considered 345 kV loop and create an alternative transmission feed for the 345 kV source at Riverton as soon as possible. Creating this bi-directional feed would address the previously discussed reliability criteria violations, reduce the potential for load shedding events, and increase operational flexibility of the radial Odessa EHV – Riverton 345 kV line.

The Riverton – Sand Lake 345 kV Line is a necessary component required to close the 345 kV loop from Riverton to Sand Lake to Solstice. After RPG review, in January 2017 ERCOT recommended Oncor's Riverton – Sand Lake 138 kV Line project, recommending it to be constructed to 345 kV standards but operated initially at 138 kV. Oncor filed its CCN application as such on July 21, 2017, with a final decision due from the Public Utility Commission of Texas (PUCT) before July 21, 2018. Currently, a Proposal for Decision (PFD) is expected to be reviewed at the PUCT Open Meeting on May 10, 2018, in which there were no exceptions filed to the PFD's recommendation to approve the project. Assuming the new Riverton – Sand Lake line will be constructed to 345 kV standards, ERCOT's critical designation for this line's upgrade to 345 kV operation will allow for a faster ability to place this new 345 kV circuit into service.

In addition to the Riverton – Sand Lake 345 kV Line, the Sand Lake – Solstice and the Bakersfield – Solstice 345 kV Lines are required to close the 345 kV loop. AEP Texas and LCRA TSC have been actively working on the CCN Application for the Bakersfield – Solstice 345 kV Line and plan to file with the PUCT for approval of this line in the Fall of 2018. Oncor and AEP Texas will be initiating appropriate environmental and routing assessments for the Sand Lake – Solstice 345 kV Line shortly, with plans to also file the CCN application in the Fall of 2018 concurrent with the Bakersfield – Solstice 345 kV Line application.

As mentioned in previous correspondence, Oncor is implementing remedial operational schemes to mitigate post-contingency voltage violations in The Culberson Loop area until additional facilities can be built to reliably serve the increasing load. This will include various low voltage load shed schemes, transfer trip schemes, and load restoration procedures. In some instances, these measures will prohibit timely restoration of customers' electricity service, putting potentially hundreds of megawatts of continuous process type customer loads at risk of extended service interruptions depending on the outage scenario. Without a looped 345 kV source supplying The Culberson Loop, reliably serving the expected 1000+ MW of load in that area will be problematic. As a result, a critical need exists in this area of the ERCOT system to relieve the multiple operational challenges through the construction and operation of the 345 kV infrastructure described in this letter.

It is for these multiple operational and reliability needs that Oncor, AEPSC, and LCRA TSC are requesting critical designation status for the Riverton – Sand Lake 345 kV Line, the Sand Lake – Solstice 345 kV Line, and the Bakersfield – Solstice 345 kV Line. With the critical designation and six month administrative review at the PUCT, the in-service dates for these projects could be accelerated by six months or more, which would allow the utilities to serve the committed load more reliably and minimize the timeframe the system would be subject to the operational risks described above. The needed 345 kV infrastructure is critical to the ability to reliably serve loads already interconnected as well as the expected load growth in this area of the ERCOT system.

Best regards,

Eithar Nashawati

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Director – Assets Planning
Oncor Electric Delivery

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Director, Transmission Planning
AEP Service Company

CC: Warren Lasher
Woody Rickerson
Jeff Billo

Cheryl Mele

ercot

ELECTRIC RELIABILITY COUNCIL OF TEXAS, INC.
BOARD OF DIRECTORS RESOLUTION

WHEREAS, after due consideration of the alternatives, the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT) deems it desirable and in the best interest of ERCOT to accept ERCOT staff's recommendation to (1) endorse the need for the Far West Regional Planning Group (RPG) Projects (Option 3), which ERCOT staff has independently reviewed and which the Technical Advisory Committee (TAC) has voted unanimously to endorse, based on North American Electric Reliability Corporation (NERC) and ERCOT planning reliability criteria, and (2) designate the Riverton-Sand Lake, Sand Lake-Solstice, and Solstice-Bakersfield 345 kV lines as critical to the reliability of the ERCOT System pursuant to Public Utility Commission of Texas (PUCT) Substantive Rule 25.101(b)(3)(D);

THEREFORE, BE IT RESOLVED, that the ERCOT Board hereby (1) endorses the need for the Far West RPG Projects (Option 3), which ERCOT staff has independently reviewed and which TAC has voted unanimously to endorse, based on NERC and ERCOT planning reliability criteria, and (2) designates the Riverton-Sand Lake, Sand Lake-Solstice, and Solstice-Bakersfield 345 kV lines as critical to the reliability of the ERCOT System pursuant to PUCT Substantive Rule 25.101(b)(3)(D).

CORPORATE SECRETARY'S CERTIFICATE

I, Vickie G. Leady, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its June 12, 2018 meeting, the ERCOT Board passed a motion approving the above Resolution by unanimous voice vote with no abstentions.

IN WITNESS WHEREOF, I have hereunto set my hand this 12th day of June, 2018.

Vickie G. Leady

Vickie G. Leady
Assistant Corporate Secretary

ATTACHMENT NO. 10

ERCOT Independent Review of Oncor Far West Texas Project 2 and Dynamic Reactive Devices

Version 1.0

Document Revisions

Date	Version	Description	Author(s)
05/21/2018	1.0	Final Report	Xiaoyu Wang, Ying Li, Priya Ramasubbu
		Reviewed by	Prabhu Gnanam, Shun Hsien (Fred) Huang, Jeff Billo

Table of Contents

1. Executive Summary

In June 2017 the ERCOT Board of Directors endorsed the Far West Texas Project (FWTP), a Tier 1 transmission project to address the transmission needs both in the Culberson Loop area and the Barilla Junction area that could reliably serve the Culberson Loop load up to 717 MW. Since the approval of the FWTP project in 2017, Oncor has confirmed that the Culberson Loop has contractually-confirmed load levels that surpass ERCOT's indicated 717 MW limit for the approved Far West Texas Project. Therefore, the endorsed FWTP project was assumed to be in-service in 2020 for the purpose of this study

In December, 2017, Oncor submitted the Far West Texas Dynamic Reactive Devices (DRD) Project to the Regional Planning Group (RPG) to meet the summer 2019 Culberson Loop load need. The proposed DRD project was estimated to cost $86 million and was classified as Tier 1 project. At the time the DRD project was proposed, the Culberson Loop was projected to have 650 MW by 2019 and 790 MW by 2022 with the inclusion of the existing and confirmed load requests in the area

In February, 2018, Oncor submitted the Far West Texas Project 2 (FWTP2) to address reliability requirements and ensure the transmission system in the area is able to meet the projected contractually-confirmed load level in the Culberson Loop. The proposed FWTP2 project was estimated to cost $194 million and was classified as a Tier 1 project. At the time the FWTP2 project was proposed, the Culberson Loop was projected to have 775 MW by 2019 and 1013 MW by 2022 with the inclusion of the existing and confirmed load requests in the area

As of April, 2018, Oncor has confirmed that the Culberson Loop now has contractually-confirmed load levels of 880 MW for 2019 and 1013 MW for 2022 Oncor has also indicated that additional, known potential (not yet contractually-confirmed) load increases in the Culberson Loop may push the total to 1339 MW

Based on the DRD and FWTP2 proposals, ERCOT completed the combined independent review for both projects together to determine the system needs for both near-term and long-term in a cost effective manner while providing flexibility to meet potential load growth in this region.

Based on the forecasted loads and scenarios analyzed, ERCOT determined that there is a reliability need to improve the transmission system in Far West Texas. After consideration of several project alternatives ERCOT concluded that the upgrades identified in Option 3 meet the reliability criteria in the most cost effective manner while providing flexibility to accommodate near-term and future load growth in the area of study Option 3 is estimated to cost $327 5 million and is described as follows

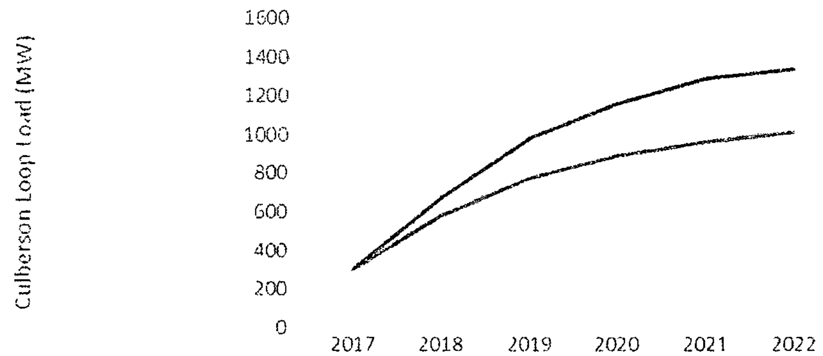
- Construct a new approximately 40-mile 345 kV line on double-circuit structures with two circuits in place from Sand Lake Switch Station to Solstice Switch Station
- Add two new 600 MVA, 345/138 kV autotransformers at Sand Lake 345 kV Switch Station
- Install a new 345 kV circuit on the planned Riverton – Sand Lake double circuit structures
- Install the second 345 kV circuit on the Odessa EHV – Riverton 345 kV line double circuit structures between Moss and Riverton (creating a Moss – Riverton 345 kV circuit)
- Construct a new Quarry Field 138 kV Switch Station in the Wink – Riverton double circuit 138 kV line

- Construct a new approximately 20-mile Kyle Ranch – Riverton 138 kV line on double-circuit structures with one circuit in place from Kyle Ranch 138 kV Switch Station to Riverton 138 kV Switch Station
- Construct a new approximately 20-mile Owl Hills – Tunstill – Riverton 138 kV line on double circuit structures with one circuit in place from Owl Hills 138 kV Switch Station to Riverton 138 kV Switch Station
- Install the second 345 kV circuit on the planned Solstice Switch Station – Bakersfield Switch Station double circuit structures
- Install one 250 MVAR STATCOM at Horseshoe Springs 138 kV Switch Station
- Install one 250 MVAR STATCOM at Quarry Field 138 kV Switch Station
- Install 150 MVAR static capacitors at Horseshoe Springs 138 kV Switch Station.
- Install 150 MVAR static capacitors at Quarry Field 138 kV Switch Station

Reactive support components, including the STATCOMs and capacitors, should be implemented by 2019 if feasible to accommodate the projected 880 MW Culberson Loop demand. Remedial operational schemes may be required in the Culberson Loop area to mitigate post-contingency voltage violations in the near-term until all of the recommended transmission upgrades can be put in-service to meet the Culberson Loop area load growth.

2. Introduction

Over the past several years the Far West Texas Weather Zone has experienced high load growth Between 2010 and 2016 the average annual growth rate was roughly 8% This strong growth rate was primarily driven by increases in oil and natural gas related demand. Figure 2 1 shows the total projected load (MW) served from the Culberson Loop as indicated in the Oncor's Far West Texas Project 2 (FWTP2) RPG proposal



	2017	2018	2019	2020	2021	2022
Confirmed Load Request	300.6	580.2	775 4	893	964.4	1013 1
Total Projected Load Additions	300.6	670 3	983.8	1163 4	1292	1339.8

Year

Figure 2.1: Total Projected Load (MW) in the Culberson Loop

Load growth along the Culberson Loop has led to several transmission improvements in the area, including the Far West Texas Project (FWTP) which was endorsed by the ERCOT Board of Directors in June, 2017. The FWTP is expected to be implemented by 2020 and will be able to serve up to 717 MW of Culberson Loop load Significant new load requests to connect to the Culberson Loop have been observed since the approval of FWTP in 2017 due to growth in the oil and gas activity As of April, 2018, the Permian Basin oil and natural gas rig count addition by county, as shown in Figure 2 2 has increased by 28% compared to April 2017. Also, more than 70% of newly added rigs since April, 2017 are located in the counties served by the Culberson Loop transmission system (Culberson, Reeves, Ward, Crane, Loving, and Winkler Counties).

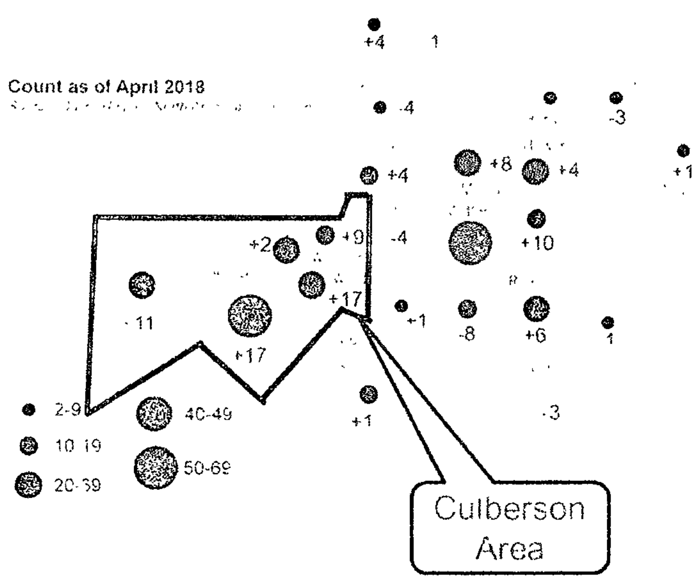


Figure 2.2 Permian Basin Oil and Natural Gas Rig Count Addition since April, 2017

In December, 2017, Oncor submitted to RPG the Far West Texas Dynamic Reactive Devices (DRD) Project, designed to meet the expected summer 2019 Culberson Loop load. The proposed DRD project was estimated to cost $86 million and was classified as a Tier 1 project. At the time of the DRD project RPG submittal, the Culberson Loop load, with the inclusion of all contractually confirmed load, was projected to be 650 MW by 2019 and 790 MW by 2022. The major components of DRD project proposal were:

- Construct a new Horseshoe Springs 138 kV Switch Station in the Riverton – Culberson 138 kV Double-circuit line
- Install two 250 MVAR, 138 kV Static Synchronous Compensators (STATCOMs) at Horseshoe Spring 138 kV Switch Station

In February, 2018, Oncor submitted the Far West Texas Project 2 (FWTP2) to address reliability requirements and ensure the transmission system in the area is able to meet the projected load. The proposed FWTP2 project was estimated to cost $194 million and was classified as a Tier 1 project. At the time the FWTP2 project was proposed, the Culberson Loop area load, again based on contractually confirmed load requests, was projected to serve 775 MW by 2019 and 1013 MW by 2022. Figure 2.3 shows the proposed FWTP2. The major components of the FWTP2 project proposal include.

- Construct a new approximately 40-mile 345 kV line on double-circuit structures with one circuit in place from Sand Lake 345 kV Switch Station to Solstice 345 kV Switch Station
- Add two new 600 MVA, 345/138 kV autotransformers at Sand Lake 345 kV Switch Station
- Install a new 345 kV circuit on the planned Riverton – Sand Lake double circuit structures
- Install the second 345 kV circuit on the Odessa EHV – Riverton 345 kV line double circuit structures between Moss and Riverton (creating a Moss – Riverton 345 kV circuit)

- Construct a new Quarry Field 138 kV Switch Station in the Wink – Riverton double-circuit 138 kV line
- Construct a new approximately 20-mile Kyle Ranch – Riverton 138 kV line on double-circuit structures with one circuit in place from Kyle Ranch 138 kV Substation to Riverton 138 kV Switch Station
- Construct a new approximately 20-mile Owl Hills – Tunstill – Riverton 138 kV line on double circuit structures with one circuit in place from Owl Hills 138 kV Switch Station to Riverton 138 kV Switch Station

As of April, 2018, Oncor has updated the contractually confirmed Culberson area load to be 880 MW by summer 2019 and 1013 MW by 2022 Additional load requests could potentially push the load to more than 1300 MW in the Culberson Loop.

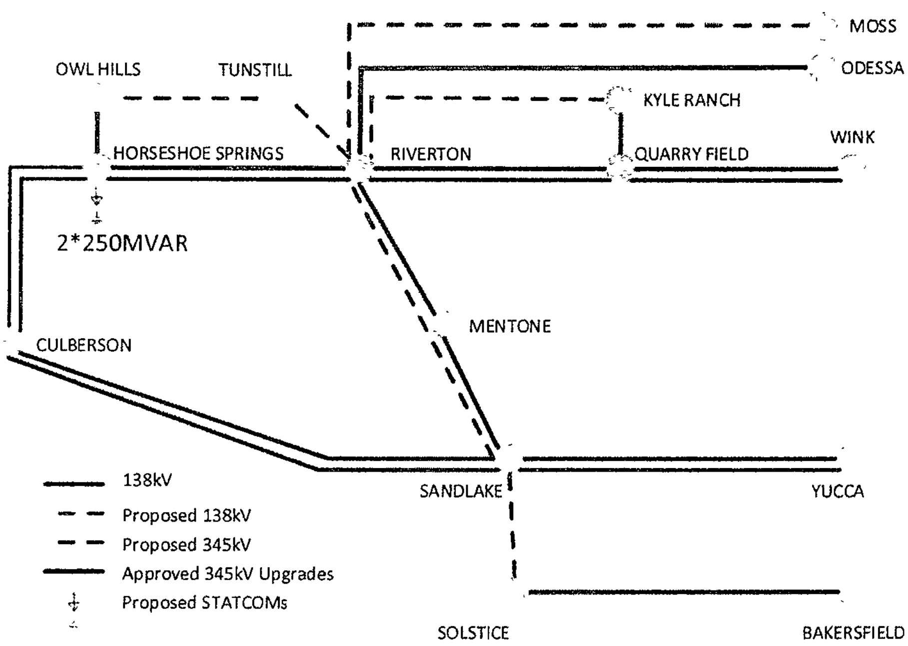


Figure 2.3: Proposed Far West Texas Project 2

Based on both the DRD and the FWTP2 proposals, ERCOT completed this independent review to determine the system needs in the Culberson Loop area and to address those needs in a cost-effective manner while providing the flexibility to meet near-term and potential long-term load growth in this area

3. Study Assumption and Methodology

ERCOT performed studies under various system conditions to evaluate the system need and identify a cost-effective solution to meet those needs in the area The assumptions and criteria used for this review are described in this section.

3.1. Study Assumption

The primary focus of this review is the Wink – Culberson – Yucca Drive loop transmission system referred to as the "Culberson Loop " Figure 3 1 shows the system map of the study area

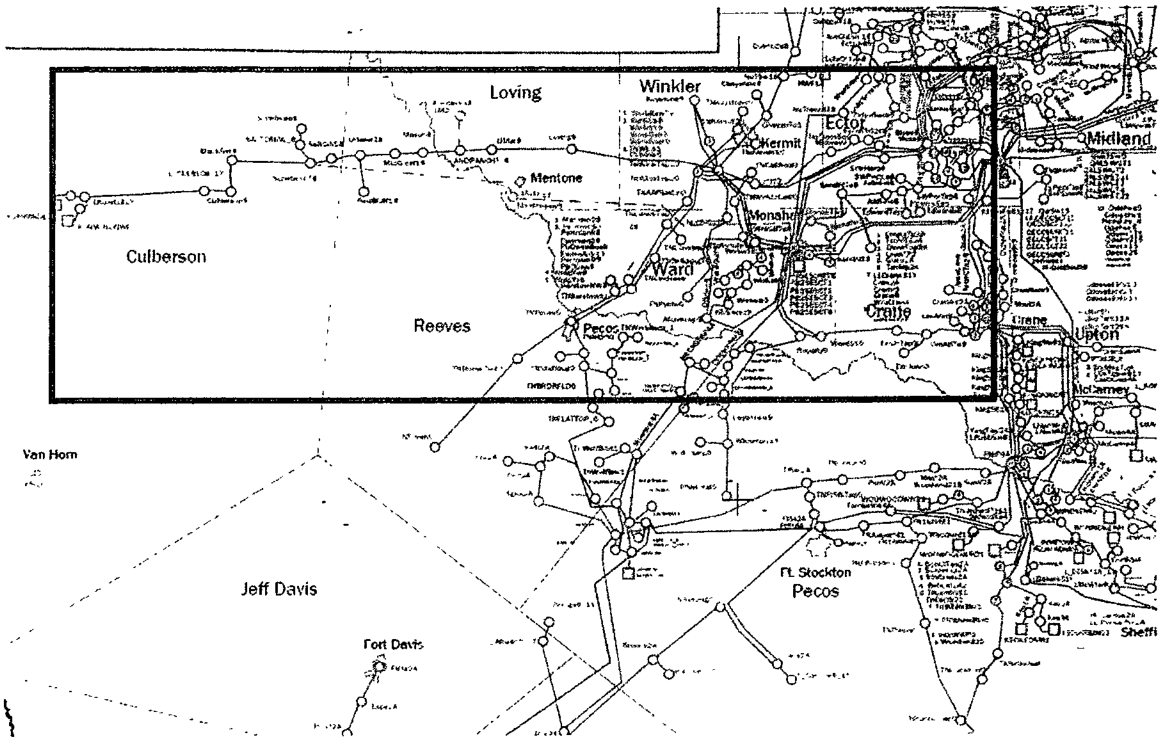


Figure 3.1: Transmission System Map of Study Area

Reliability Cases

The following starting cases were used in the study.

- The 2020 West/Far West (WFW) summer peak case from the 2017 RTP reliability case
- The 2020 Dynamics Working Group summer peak flat start case

Transmission Topology

The starting case was modified based on input from Oncor to include topological changes, switched shunt additions and load additions in the study area for both near-term 2019 summer peak and 2022 summer peak conditions

Study Case Loads and Potential Loads

Oncor provided data regarding increased load projections in the Culberson Loop area. The most recent Oncor submittal data included 880 MW for 2019 summer peak and 1030 MW for 2022 summer peak in the Culberson Loop area. Oncor met with ERCOT and shared information on the signed customer agreements which confirmed these proposed load additions.

Sensitivity cases were also created to reflect higher potential load projections from Oncor. These cases contained additional customer load requests that did not yet have firm commitment at the time of this independent review. To reflect this "Potential" load growth, the load was increased by 334 MW in the Culberson Loop for 2022 summer peak. The total load in the Potential Load Case was approximately 1347 MW in the Culberson Loop for the Potential Load sensitivity.

Generation

Planned generators in the Far West and West Weather Zones that met Planning Guide Section 6.9 conditions for inclusion in the base cases (according to the 2016 October Generation Interconnection Status report), which were not included in the RTP cases, were added. The added generators are listed in Table 3.1.

Table 3.1 Added Generators That Met Planning Guide Section 6.9 Conditions (2018 April GIS report)

GINR Number	Project Name	MW	Fuel	County	Weather Zone
14INR0044	West of Pecos Solar	100	Solar	Reeves	Far West

Key assumptions applied in this study include the following.

- Wind generation in West and Far West weather zones were set to have a maximum dispatch capability of 2.6% of their rated capacity. This assumption was in accordance with the 2016 Regional Transmission Plan Study Scope and Process document.[1]
- Solar generation was set at 70% of their rated capacity in accordance with the 2016 Regional Transmission Plan Study Scope and Process document.
- Considering the oil and gas industry load characteristics (flat load), the most stressed system condition is during the night when solar generation is not available. To study this condition, no solar generation was dispatched in the study base conditions.

Capital Cost Estimates

Capital cost estimates for transmission facilities were provided by Oncor, AEPSC and LCRA TSC. These costs were provided for individual transmission facilities and ERCOT used those values to calculate total project costs for various project options.

3.2. Criteria for Violations

The following criteria were used to identify planning criteria violations.

All 100 kV and above busses, transmission lines and transformers in the study region were monitored (excluding generator step-up transformers).

- Thermal criteria violations
    - Rate A for Normal Conditions

[1] http://www.ercot.com/content/wcm/key_documents_lists/77730/2016_PTP_Scope_Process_v1.3_clean.pdf

- Rate B for Emergency Conditions

- Voltage violation criteria
    - 0.95 < V pu < 1.05 Normal
    - 0.90 < V pu < 1.05 Emergency
    - Post Contingency voltage deviations
        - 8% on non-radial load buses
- Dynamic Stability Analysis
    - NERC TPL-001-4 and ERCOT Planning Guide Section 4

3.3. Study Tools

ERCOT utilized the following software tools for the independent review of the Far West Texas Project

- PSS/e version 33 was used to perform the dynamic stability analysis and in the initial steady-state case creation to incorporate the TSP idvs files
- PowerWorld Simulator version 20 for SCOPF and steady state contingency analysis
- VSAT version 17 was used for voltage stability analysis
- UPLAN version 10.2.0.19928

4. Project Need

The need for a transmission improvement project was evaluated for the Study Case. Table 4.1 summarized the steady state voltage stability (Power-Voltage) assessment results for the 2019 summer peak. The results showed pre-contingency voltage stability issues with no transmission upgrades. Even with the addition of the ERCOT Board of Directors approved Far West Texas Project (FWTP), as shown in Table 4.1 Scenario 2, the results indicated both voltage violations and voltage collapse under certain contingencies for the projected Culberson Loop 2019 summer peak load. The project need analysis results are consistent with the finding of the 2017 FWTP ERCOT independent review that identified the need for additional upgrades (beyond the FWTP project endorsed in June 2017) to serve loads greater than 717 MW in the Culberson Loop.

Table 4.1 Steady State Voltage Stability Assessment for the Base Case Condition

Scenario	Load (MW)	Transmission Upgrades	Culberson Load Serving Capability	
			NERC P1 P7	NERC P6
1	880 (2019 Summer Peak)	None	Pre-contingency Voltage Collapse	
2	880 (2019 Summer Peak)	FWTP(1)	Voltage Violation Voltage Collapse	Voltage Violation Voltage Collapse

(1) The Far West Texas Project (FWTP) endorsed by ERCOT Board of Directors in June, 2017

5. Project Options

5.1. Options Considerations

The FWTP, which was endorsed by the ERCOT Board of Directors in June 2017, was designed to allow for a number of different expansion options that could accommodate additional load growth. All project alternatives considered in this study align with the expansion options evaluated as part of the ERCOT FWTP independent review.

In addition, project options considered in this study were limited to alternatives that included adding a second 345 kV circuit to the Odessa EHV – Riverton (between Moss and Riverton) and Solstice – Bakersfield 345 kV lines. This limitation was result of the following considerations:

- The Culberson Loop area has experienced a significant rate of load growth. This evaluation focused on contractually committed load with a sensitivity evaluation which includes new customers that have contacted the TSPs with load requests but have not yet finalized a contract to construct. However, it is possible that more, presently unknown, load requests will materialize before the facilities recommended in this evaluation are in service.
- The Odessa EHV – Riverton and Solstice – Bakersfield 345 kV lines have yet to be constructed. If they were constructed with one circuit in place and a second 345 kV circuit was later deemed necessary, the construction outage to add the second circuit would greatly reduce the load serving capability to the Culberson Loop and reduce the operational flexibility during what would likely be a long duration outage.
- It is approximately 50% less expensive to construct the two circuits in place at the initial build than the cost of coming back to install the second circuit at a later time due to reduced access, environmental and mobilization costs and construction efficiencies.

In addition, the new 138 kV lines proposed in the FWTP2 project are necessary to strengthen the Culberson Loop and provide operational flexibility under normal and outage conditions.

5.2. Short-Listed Options

Based on the considerations listed above and the results of preliminary analysis, the following "universal" transmission upgrades were included in all of the short-listed options:

- Construct a new approximately 40-mile 345 kV line on double-circuit structures with two circuits in place from Sand Lake 345 kV Switch Station to Solstice 345 kV Switch Station
- Add two new 600 MVA, 345/138 kV autotransformers at Sand Lake 345 kV Switch Station
- Install a new 345 kV circuit on the planned Riverton – Sand Lake double circuit structures
- Install the second 345 kV circuit on the Odessa EHV – Riverton 345 kV line double circuit structures between Moss and Riverton (creating a Moss – Riverton 345 kV circuit)
- Construct a new Quarry Field 138 kV Switch Station in the Wink – Riverton double-circuit 138 kV line
- Construct a new approximately 20-mile Kyle Ranch – Riverton 138 kV line on double-circuit structures with one circuit in place from Kyle Ranch 138 kV Substation to Riverton 138 kV Switch Station

- Construct a new approximately 20-mile Owl Hills – Tunstill – Riverton 138 kV line on double circuit structures with one circuit in place from Owl Hills 138 kV Switch Substation to Riverton 138 kV Switch Station
- Install the second 345 kV circuit on the planned Solstice Switch Station – Bakersfield Switch Station double circuit structures

The following three options were studied further for the reactive support in the Culberson Loop. The detailed description of the three short-listed options are provided below and diagrams for these are included in the Appendix.

Option 1

- Universal transmission upgrades
- Install two 250 MVAR Static Synchronous Compensators (STATCOMs) at Horseshoe Springs 138 kV Switch Station

The total cost estimate for Option 1 is approximately $300.0 Million.

Option 2

- Universal transmission upgrades
- Install one 250 MVAR Static Synchronous Compensators (STATCOMs) at Horseshoe Springs 138 kV Switch Station
- Install capacitor banks with a total capacity of 150 MVAR at Horseshoe Springs 138 kV Switch Station
- Install capacitor banks with a total capacity of 150 MVAR at Quarry Field 138 kV Switch Station

The total cost estimate for Option 2 is approximately $292.5 Million

Option 3

- Universal transmission upgrades
- Install one 250 MVAR Static Synchronous Compensators (STATCOMs) at Horseshoe Springs 138 kV Switch Station
- Install one 250 MVAR Static Synchronous Compensators (STATCOMs) at Quarry Field 138 kV Switch Station
- Install capacitor banks with a total capacity of 150 MVAR at Horseshoe Springs 138 kV Switch Station
- Install capacitor banks with a total capacity of 150 MVAR at Quarry Field 138 kV Switch Station

The total cost estimate for Option 3 is approximately $327.5 Million

6. Voltage Stability and Dynamic Stability Analysis

A Power-Voltage (PV) analysis was used in the steady state voltage stability assessment for the Culberson Loop area for all short-listed options for the studied scenarios. A Power-Voltage (PV) analysis was used to proportionally increase the load in the Culberson Loop until a voltage collapse identified the maximum load serving capability for the options. Table 7.1 shows the results of this analysis, indicating the maximum loads in the Culberson Loop area that can be reliably served by the three identified project options. A sensitivity analysis was conducted to evaluate the impact of nearby generators to the Culberson Loop load serving capability. All five generators at the Permian Basin (PBSES) generation station were off-line in the study case. The PV results are in listed in Table 7.1.

Table 7.1 Voltage and Dynamic Stability Assessment of All Options for Culberson Loop Load Serving Capability

	Culberson Loop Load Served (MW)		
Description	Option 1	Option 2	Option 3
PV Voltage Collapse Results (NERC P1, P6, P7, ERCOT Events)	1608	1568	1688
PV Voltage Collapse Results (without PBSES Units) (NERC P1, P6, P7, ERCOT Events)	1508	1468	1548
Dynamic Stability Result (without PBSES Units) (NERC P1, P6, P7, ERCOT Events)(1)	Acceptable	Acceptable	Acceptable
Estimated Capital Cost ($M)	300	292.5	327.5

(1) Dynamic stability was conducted at the Culberson Loop load level identified in the PV voltage collapse results

The majority of the loads in the study area were assumed to be oil and gas customers who employ voltage-sensitive electric equipment in their operations. As specified by Oncor, heavy motor load was assumed to represent the load characteristic in the study area. All three options were tested using time domain dynamic stability simulations including a dynamic load model provided by Oncor to evaluate system stability.

It was assumed that if simulations indicated an acceptable (stable) system response following severe events and/or three-phase faults, the stability response would also be acceptable for the same events with a single-line-to-ground (SLG) fault. If a potential stability issue was observed, the simulation was rerun with SLG faults to ensure a stable system response following a NERC planning event. In this way the analysis demonstrated compliance with NERC planning standards and ERCOT reliability criteria. In these simulations, selected ERCOT transmission buses were monitored for angle and voltage responses.

The dynamic event definitions included the removal of all elements that the protection system and other automatic controls are expected to disconnect for each event. The dynamic simulation results are also listed in Table 7.1.

None of the three options will be fully in-service prior to summer 2019, when the load is projected to reach 880 MW, since the new transmission lines will not be constructed. As a result, a PV analysis was conducted for the 2019 summer condition assuming only the reactive devices in all three options can be implemented to support the Culberson Loop in 2019. The PV analysis results are listed in Table 7.2. The results indicate that for Options 1 and 2 additional operational mitigation measures will be needed to maintain reliability prior to the new transmission lines being put in place. These operational mitigation measures may include (but are not limited to) undervoltage load shed

Table 7.2 Steady State Voltage Stability Assessment of All Options for Culberson Loop Load Serving Capability with Reactive Devices Only

	Culberson Loop Load Served (MW)		
Description	Option 1	Option 2	Option 3
PV Voltage Collapse Results (reactive devices only[1]) (NERC P1 P6, P7 ERCOT Events)	801	82[illegible]	100[illegible]
PV Voltage Collapse Results (without PBSES units) (reactive devices only[1]) (NERC P1 P6 P7 ERCOT Events)	721	741	88[illegible]

(1) Assuming reactive devices will be in service before new transmission lines

(2) Oncor indicated that the reactive devices identified to be located at Quarry Field 138 kV Switch Station may not be in service by summer 2019. ERCOT performed a PV analysis considering only the reactive devices located at Horseshoe Springs from Option 3. The results showed that without the Quarry Field reactive devices in service, Option 3 would have a load serving capability of 721 MW.

7 Economic Analysis

Although this RPG project is driven by reliability needs, ERCOT also conducted an economic analysis to identify any potential impact on system congestion related to the addition of the transmission upgrades.

The base case for this economic analysis used the 2023 economic case built for the 2017 PTP as the starting case. The topology changes and generation additions were similar to the steady state base case built. ERCOT modeled each of the three short-listed options and performed production cost simulations for the year 2023. The annual production analysis showed no measurable congestion impact on the ERCOT System with the addition of the transmission upgrades.

8. Subsynchronous Resonance (SSR) Vulnerability Assessment

According to Protocol Section 3.22.1.3(2), ERCOT performed a SSR vulnerability assessment using topology check and the results indicated that all three short-listed options strengthen the transmission network and increase the required transmission circuit outages to have a Generation Resource become radial to series capacitors. The SSR assessment results showed no SSR vulnerability for any existing Generation Resources or Generation Resources satisfying Planning Guide Section 6.9 conditions for inclusion in the planning models at the time of this study.

9. Final Options Comparison

As shown in Table 9.1, a comparison of study results for the three options shows that Option 3, shown in Figure 9.1, met the system reliability criteria under the studied load conditions while providing better load serving capability to accommodate both the near-term and potential future load needs in the Culberson Loop area

Table 9.1 Options Comparison

Description	Option 1	Option 2	Option 3
Capital cost ($ Million)	300.0	292.5	327.5
PV Results, Culberson Load Served	1608	1568	1688
PV Results, Culberson Load Served (with only reactive support devices recommended in the options)	801	821	1001
PV Results, Culberson Load Served (without PBSES Units)	1508	1468	1648
PV Results, Culberson Load Served (without PBSES Units) (with only reactive support devices recommended in the options)	721	741	880
Dynamic Stability Results, Culberson Load Served	Acceptable	Acceptable	Acceptable

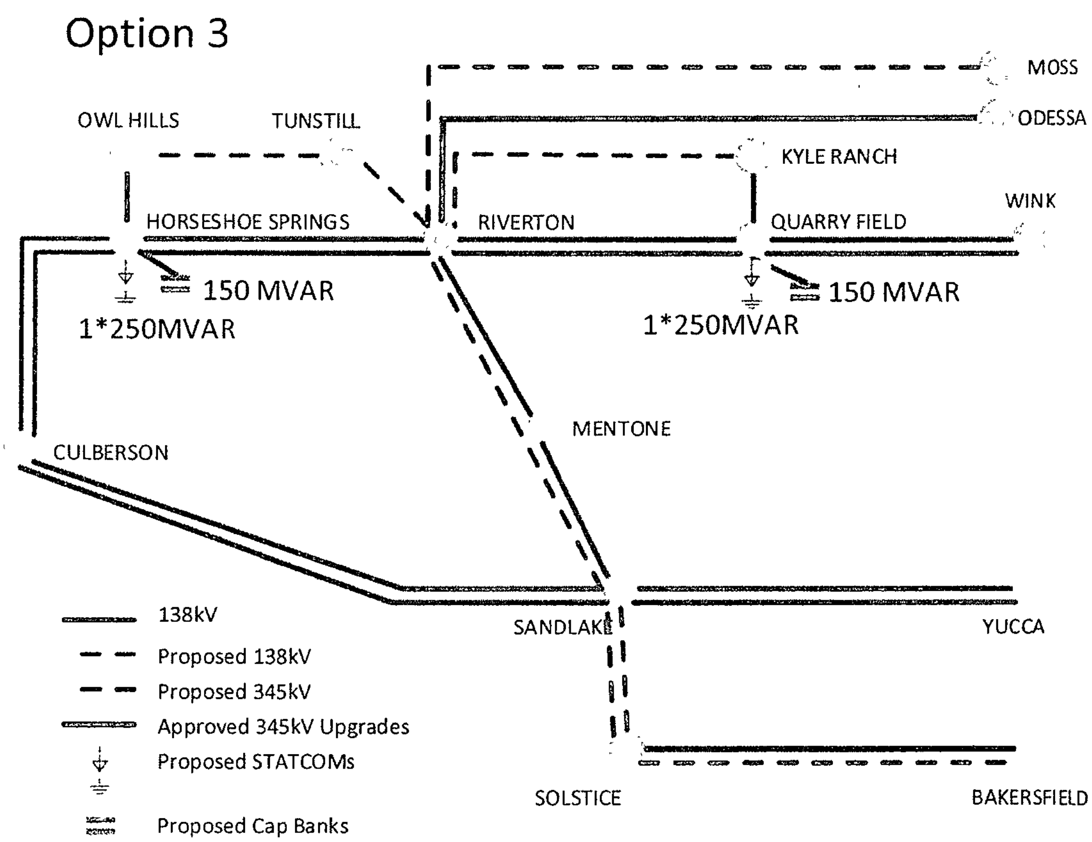


Figure 9.1: Option 3

10. Sensitivity Studies

Sensitivity studies were performed to ensure compliance with Planning Guide requirements.

10.1. Generation Sensitivity Analysis

According to Planning Guide Section 3.1.3(4)(a), the generation sensitivity analysis will evaluate the effect that proposed Generation Resources in or near the study area will have on a recommended transmission project. Based on the 2018 April Generator Interconnection Status report, Table 10.1.1 shows all the generators in the area that met Planning Guide 6.9 and Table 10.1.2 shows all the generators in the area with a signed standard generator interconnection agreement (SGIA) that did not meet Planning Guide 6.9 conditions for inclusion in the planning models. Considering the oil and gas industry load characteristics, the most stressed system condition is during the night when solar generation is not available. No solar generation in the Culberson Loop was assumed available in the study base conditions. Therefore, the proposed Generation Resources in the Culberson Loop area will have no impact on the recommended transmission project.

Table 10.1.1 Generators Met Planning Guide Section 6.9 Conditions (2017 March GIS report)

GINR Number	Project Name	MW	Fuel	County	Weather Zone
14INR0044	West of Pecos Solar	100	Solar	Reeves	Far West

Table 10.1.2 Generators with SGIA That Did Not Meet Planning Guide Section 6.9 Conditions (2017 March GIS report)

GINR Number	Project Name	MW	Fuel	County	Weather Zone
18INR0022	Winkler Solar	150	Solar	Winkler	Far West

10.2. Load Scaling Impact Analysis

Planning Guide Section 3.1.3(4) (b) requires evaluation of the impact of various load scaling on the criteria violations seen in the study cases.

Because the voltage violations were observed at load serving buses inside the Culberson Loop, ERCOT assumed that the load scaling in the outside weather zones did not have a material impact on the observed need.

11. Conclusion

Based on the forecasted loads and scenarios analyzed, ERCOT determined that there is a reliability need to improve the transmission system in Far West Texas. After consideration of the project alternatives, ERCOT concluded that the upgrades identified in Option 3 meet the reliability criteria in the most cost effective manner and provide needed load serving capability to the rapid oil and gas industry load growth in the Culberson Loop area. Option 3 is estimated to cost $327.5 million and is described as follows

- Construct a new approximately 40-mile 345 kV line on double-circuit structures with two circuits in place from Sand Lake 345 kV Switch Station to Solstice 345 kV Switch Station
- Add two new 600 MVA, 345/138 kV autotransformers at Sand Lake 345 kV Switch Station
- Install a new 345 kV circuit on the planned Riverton – Sand Lake double circuit structures
- Install the second 345 kV circuit on the Odessa EHV – Riverton 345 kV line double circuit structures between Moss and Riverton (creating a Moss – Riverton 345 kV circuit)
- Construct a new Quarry Field 138 kV Switch Station in the Wink – Riverton double-circuit 138 kV line
- Construct a new approximately 20-mile Kyle Ranch – Riverton 138 kV line on double-circuit structures with one circuit in place from Kyle Ranch 138 kV Substation to Riverton 138 kV Switch Station
- Construct a new approximately 20-mile Owl Hills – Tunstill – Riverton 138 kV line on double circuit structures with one circuit in place from Owl Hills 138 kV Switch Substation to Riverton 138 kV Switch Station
- Install the second 345 kV circuit on the planned Solstice 345 kV Switch Station – Bakersfield 345 kV Switch Station double circuit structures
- Install one 250 MVAR STATCOM at Horseshoe Springs 138 kV Switch Station
- Install one 250 MVAR STATCOM at Quarry Field 138 kV Switch Station
- Install 150 MVAR static capacitors at Horseshoe Springs 138 kV Switch Station
- Install 150 MVAR static capacitors at Quarry Field 138 kV Switch Station

The reactive support components including STATCOMs and capacitors recommended in Option 3 should be implemented by 2019 if feasible to accommodate the projected 850 MW Culberson Loop in summer 2019. Additionally, the sizing of capacitor bank stages should take into account operational considerations. Remedial operational schemes may be required to mitigate post-contingency voltage violations in the Culberson Loop area until the recommended transmission upgrades can be built to reliably serve the increasing load

12. Designated Provider of Transmission Facilities

In accordance with the ERCOT Nodal Protocols Section 3.11.4.8 ERCOT staff is to designate transmission providers for projects reviewed in the RPG. The default providers will be those that own the end points of the new projects. These providers can agree to provide or delegate the new facilities or inform ERCOT if they do not elect to provide them If different providers own the two ends of the recommended projects ERCOT will designate them as co-providers and they can decide between themselves what parts of the recommended projects they will each provide.

Oncor owns the Odessa EHV Switch Station, Moss Switch Station and is planning to construct and own the new Riverton Switching Station and therefore is the presumed owner of the Riverton Switching Station Therefore, ERCOT designates Oncor as the designated provider for the 345 kV Odessa EHV to Riverton and Moss to Riverton transmission facilities along with the two recommended 345/138 kV autotransformers at Riverton

LCRA TSC owns the Bakersfield Switchyard while AEPSC is constructing and planning to own the new Solstice Substation and therefore is the presumed owner of the Solstice Substation Therefore, ERCOT designates AEPSC and LCRA TSC as the designated co-providers for the 345 kV Bakersfield to Solstice transmission facilities but AEPSC as the provider of the two recommended 345/138 kV autotransformers at Solstice

Oncor is planning to construct and own the new Sand Lake Switching Station and therefore is the presumed owner of the Sand Lake Switching Station, while AEPSC is constructing and planning to own the new Solstice Substation and therefore is the presumed owner of the Solstice Substation ERCOT designates Oncor and AEPSC as the designated co-providers for the 345 kV Sand Lake to Solstice transmission facilities and Oncor as the provider of the two recommended 345/138 kV autotransformers at Sand Lake Switch Station.

Oncor owns all the 138 kV Switch Stations listed in the recommended Option 3. Therefore, ERCOT designates Oncor as the designated provider for all the 138 kV transmission facilities along with the proposed STATCOMs and static capacitor banks

The designated TSPs have requested critical designation status for the Riverton – Sand Lake 345 kV Line, the Sand Lake – Solstice 345 kV Line, and the Bakersfield – Solstice 345 kV line for multiple operational and reliability needs to address the rapid load growth in the Culberson Loop area. ERCOT designates the project critical to reliability per PUCT Substantive Rule 25 101(b)(3)(D)

13. Appendix

Options Diagrams	Options_OneLine.pptx

Office Memorandum

Date: October 30, 2018

To: File

From: Brenda J. Perkins

Subject: Alternative Routes Evaluation: Sand Lake – Solstice 345 kV Transmission Line Project

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This memorandum discusses the evaluation of routing alternatives for Oncor Electric Delivery Company LLC's ("Oncor") and AEP Texas Inc.'s ("AEP Texas") proposed Salt Lake – Solstice 345 kV Transmission Line Project ("Proposed Transmission Line Project"). In addition to the recommendation for a route that best meets the requirements of the Texas Utilities Code and the Substantive Rules of the Public Utility Commission of Texas ("Commission"), alternative routes were also selected to be filed with this joint CCN Application of Oncor and AEP Texas. The goal of this process is to provide the Commission with an adequate number of alternative routes to conduct a proper evaluation. These alternative routes provide good geographic diversity while complying with Section 37.056(c)(4)(A)-(D) of the Texas Utilities Code, 16 Tex. Admin. Code § 22.52(a)(4) ("TAC"), and 16 TAC § 25.101(b)(3)(B), including the Commission's policy of prudent avoidance. The selections are based on Oncor and AEP Texas' reconnaissance and observations of the project area, both companies independent review of the data included in the *Environmental Assessment and Alternative Route Analysis for Oncor Electric Delivery Company LLC's and AEP Texas Inc.'s Proposed Salt Lake – Solstice 345 kV Transmission Line Project in Pecos, Reeves and Ward Counties, Texas* ("Environmental Assessment and Routing Study") prepared by Halff Associates, Inc. ("Halff"); discussions with Halff personnel; discussions with Oncor and AEP Texas personnel; both companies' involvement in the public participation meeting process; review of correspondence related to the Proposed Transmission Line Project; other input that Oncor and AEP Texas received from interested parties; and other information. The selections incorporate consideration of engineering feasibility, the estimated cost of alternative routes, construction limitations, and other information.

Halff documented its efforts to identify potential preliminary alternative routes for the proposed 345 kV transmission line project in Chapter 4.0 of the Environmental Assessment and Routing Study. After Halff completed the initial data gathering and constraints mapping process, preliminary alternative route links were identified on aerial photography. These preliminary alternative route links were selected considering the location of existing corridors, apparent property boundaries and routing constraints. Numerous preliminary alternative route links were identified by Halff, prior to the public participation meeting, that when combined formed many preliminary alternative routes to connect Oncor's Sand Lake Switch to the AEP Texas Solstice Switch. The preliminary alternative route links evaluated by Halff and presented at the public participation meeting are depicted in Exhibit 1 located in Appendix B of the Environmental Assessment and Routing Study.

Following the public participation meeting, Halff conducted reconnaissance surveys to evaluate and identify in the field the input, comments, and information received at the public participation

ATTACHMENT NO. 12

meeting, as well as supplement their prior work, to determine whether that information would warrant modifications to the preliminary alternative route links and/or the identification of new preliminary alternative route links that were not presented at the meeting. The preliminary alternative route link revisions are discussed in detail in Chapter 6.0 of the Environmental Assessment and Routing Study and are briefly summarized below.

In general, numerous links were modified to account for new construction identified during the September 2018 aerial reconnaissance, mostly related to oil and gas facilities. Following the preliminary alternative route link revisions, Halff identified a total of 408 alternative routes that were further evaluated, as discussed in Chapter 7.0 of the Environmental Assessment and Routing Study. These routes were presented to Oncor and AEP Texas.

Each of the 408 preliminary alternative routes identified by Halff possesses both positive and negative comparative attributes. Oncor and AEP Texas considered each of these attributes to select a set of geographically diverse routing alternatives to be filed as a part of this Application. Each alternative route complies with Section 37.056(c)(4)(A)-(D) of the Texas Utilities Code and 16 Texas Administrative Code § 25.101, including the Commission's policy of prudent avoidance.

Below, is a discussion of the alternative routes that were selected to be filed with the Application. The routes can be grouped in many different ways; one approach is the grouping of routes into geographic corridors. Alternative routes can be grouped into five different geographic corridors. These five corridors are identified as: the west corridor using Link F1; the west-central corridor using Link F2; the central corridor using Link F3; the east-central corridor using Link H1; and the east corridor using Link H2. Due to the location of this project's endpoints being on opposite sides of the Pecos River, all routes cross the Pecos River.

Oncor and AEP Texas selected 29 geographically diverse alternative routes to be filed with the CCN Application to allow for an adequate number of alternative routes to conduct a proper evaluation. The links that comprise these routes are presented in Table 1. Table 2 presents quantifiable environmental data on the 29 alternative routes filed as a part of the CCN Application.

Oncor and AEP Texas then presented these 29 alternative routes to Mr. Wilson Peppard for consideration of engineering feasibility, construction limitations and alternative route cost estimates. Below is a discussion of each of the five geographic corridors and the alternative routes selected for filing within each corridor.

The west corridor includes routes containing Link F1. The west F1 corridor routes vary in length from approximately 50.4 to 57.9 miles. The west F1 corridor routes range in transmission line costs from $111,077,000 to $123,457,000. The west F1 corridor routes vary in the number of habitable structures within 500 feet of the route centerline from 2 to 66. The west F1 corridor routes vary in the percentage of compatible corridors paralleled from 29.7% to 48.7%. The seven alternatives filed in the Application that are in the west F1 corridor include Routes 46, 49, 325, 326, 328, 329 and 370.

The west-central corridor includes routes containing Link F2. The west-central F2 corridor routes vary in length from approximately 49.7 to 56.3 miles. The west-central F2 corridor routes range in transmission line costs from $111,780,000 to $122,360,000. The west-central F2 corridor routes vary in the number of habitable structures within 500 feet of the route centerline from 2 to 66. The west-central F2 corridor routes vary in the percentage of compatible corridors paralleled from 25.5% to 37.0%. The four alternatives filed in the Application that are in the west-central F2 corridor include Routes 78, 357, 366 and 404.

The central corridor includes routes containing Link F3. The central F3 corridor routes within this corridor vary in length from approximately 44.5 to 53.4 miles. The central F3 corridor routes range in transmission line costs from $98,220,000 to $116,066,000. The central F3 corridor routes vary in the number of habitable structures within 500 feet of the route centerline from 3 to 38. The central F3 corridor routes vary in the percentage of compatible corridors paralleled from 25.4% to 38.0%. The six alternatives filed in the Application that are in the central F3 corridor are Routes 18, 41, 297, 310, 320 and 324.

The east-central corridor includes routes containing Link H1. The east-central H1 corridor routes vary in length from approximately 47.2 to 51.3 miles. The east-central H1 corridor routes range in transmission line costs from $106,217,000 to $113,652,000. The east-central H1 corridor routes vary in the number of habitable structures within 500 feet of the route centerline from 3 to 39. The east-central H1 corridor routes vary in the percentage of compatible corridors paralleled from 21.9% to 36.2%. The six alternatives filed in the Application that are in the east-central H1 corridor are Routes 13, 14, 131, 292, 293 and 296.

The east corridor includes routes containing Link H2. The east H2 corridor routes vary in length from approximately 48.8 to 58.7 miles. The east H2 corridor routes range in transmission line costs from $107,266,000 to $126,903,000. The east H2 corridor routes vary in the number of habitable structures within 500 feet of the route centerline from 2 to 38. The east H2 corridor routes vary in the percentage of compatible corridors paralleled from 17.3% to 32.9%. The six alternatives filed in the Application that are in the east H2 corridor are Routes 3, 90, 183, 280, 281 and 282.

After analyzing each of the 29 alternative routes within the five geographic corridors, Route 320 (Links A-B2-B3-C2-D2-F3-G4-G51-I2-J1-J7-L1-Z) was selected as the route that best meets the requirements of the Texas Utilities Code and the Commission's Substantive Rules.

The other significant factors which led to the selection of Route 320 include the following:

- the length of Route 320 is approximately 44.5 miles, which is the shortest alternative route (Route 183 is the longest route included in the Application at approximately 58.7 miles);
- Route 320 is estimated to cost approximately $98,220,000, which is the least expensive alternative route and is $28,683,000 less than the most expensive alternative route (Route 183);
- there are no habitable structures within the proposed right-of-way of Route 320;
- there are 38 habitable structures within 500 feet of the centerline of Route 320, of which 34 of these 38 structures are mobile living or office units that are temporarily in place and

appear to have no permanent foundations. The 32 mobile living units are of the travel trailer style and are located within 500 feet of Link B2's centerline (habitable structure map identification numbers 2-20 and 22-34). The 2 mobile office units are prefabricated mobile units located within 500 feet of Link Z's centerline at the solar facility near the Solstice Switch endpoint (habitable structure map identification numbers 67 and 68). Habitable structure counts within 500 feet of the filed routes centerlines range from 2 to 66;

- Route 320 parallels existing compatible corridors, including existing transmission lines, public roads and highways, railroads, and apparent property boundaries, for approximately 27.2% of its length (the range of alternative routes paralleling existing compatible corridors is 17.3% to 48.7%);
- Route 320 crosses no parks/recreational areas and does not have any parks/recreational areas within 1,000 feet of its centerline;
- Route 320 crosses no recorded cultural resource sites (two crossings of recorded cultural resource sites was the highest count among the filed routes);
- Route 320 has one recorded cultural resource site within 1,000 feet of its centerline (six recorded cultural resource sites within 1,000 feet of the centerline was the highest count among the filed routes);
- Route 320 has no FAA-registered airport with a runway greater than 3,200 feet within 20,000 feet of the centerline (two FAA-registered airports with a runway greater than 3,200 feet within 20,000 feet of the centerline was the highest count among the filed routes);
- Route 320 has no FAA-registered airport with a runway of 3,200 feet or less within 10,000 feet of the centerline;
- Route 320 has no commercial AM radio transmitters within 10,000 feet of its centerline;
- Route 320 has no FM radio transmitters, microwave relay stations, or other similar electronic installations within 2,000 feet of its centerline (four such electronic installations within 2,000 feet of centerline was the highest count among the filed routes);
- Route 320 crosses three US or State Highways along its entire length (US or State Highway crossings range from 2 to 3 among the filed routes);
- Route 320 crosses thirteen FM roads, county roads or other streets along its entire length (such road or street crossings range from 8 to 19 among the filed routes);
- Route 320 has been judged to be feasible from an engineering perspective based on currently known conditions without the benefit of on-the-ground and subsurface surveys, and there are no currently-identifiable engineering constraints that impact this route that cannot be addressed with additional consideration by Oncor and AEP Texas during the engineering and construction process.

After considering all of the parameters and issues as discussed in this memo, Oncor and AEP Texas selected Route 320 as the route that best meets the requirements of the Texas Utilities Code and the Commission's Substantive Rules.

Additional information concerning the issues addressed in this memorandum can be found in the Environmental Assessment and Routing Study, included as Attachment No. 1 to the CCN Application, as well as my direct testimony filed with the CCN Application.

Table 1. COMPOSITION OF ROUTES FILED IN THE CCN APPLICATION

Route	Link Sequence	Miles
3	A-B1-C3-C2-D2-E2-F4-G6-H2-J22-J3-K4-K5-L1-Z	50.0
13	A-B1-C3-C2-D2-E2-F4-H1-I3-J1-J7-L1-Z	48.4
14	A-B1-C3-C2-D2-E2-F4-H1-I3-J1-J5-J8-K5-L1-Z	51.2
18	A-B1-C3-C2-D2-F3-G2-G3-G51-G52-I3-J1-J7-L1-Z	46.7
41	A-B1-C3-C2-D2-F3-G4-G51-I2-J1-J7-L1-Z	45.7
46	A-B1-C3-C2-D1-E1-F1-I1-K11-K12-L2-Z	54.9
49	A-B1-C3-C2-D1-E1-F1-I1-K2-K3-K12-L2-Z	51.6
78	A-B1-C3-C2-D1-E1-F2-G4-G51-G52-I3-J1-J7-L1-Z	50.8
90	A-B1-C4-D31-E4-D42-F5-H2-J22-J3-K4-K5-L1-Z	52.8
131	A-B1-C4-D31-D32-E3-F4-H1-I3-J1-J7-L1-Z	51.3
183	A-B1-C4-D41-D42-F5-H2-J22-J3-K4-K5-L1-Z	58.7
280	A-B2-B3-C2-D2-E2-F4-G6-H2-J22-J3-J4-J8-K5-L1-Z	50.6
281	A-B2-B3-C2-D2-E2-F4-G6-H2-J22-J3-J4-J5-J7-L1-Z	51.7
282	A-B2-B3-C2-D2-E2-F4-G6-H2-J22-J3-K4-K5-L1-Z	48.8
292	A-B2-B3-C2-D2-E2-F4-H1-I3-J1-J7-L1-Z	47.2
293	A-B2-B3-C2-D2-E2-F4-H1-I3-J1-J5-J8-K5-L1-Z	50.0
296	A-B2-B3-C2-D2-E2-F4-H1-I3-J21-J22-J3-K4-K5-L1-Z	49.9
297	A-B2-B3-C2-D2-F3-G2-G3-G51-G52-I3-J1-J7-L1-Z	45.5
310	A-B2-B3-C2-D2-F3-G2-G1-I1-K2-K3-K12-L2-Z	53.4
320	A-B2-B3-C2-D2-F3-G4-G51-I2-J1-J7-L1-Z	44.5
324	A-B2-B3-C2-D2-F3-G4-G51-I2-J21-J22-J3-K4-K5-L1-Z	47.2
325	A-B2-B3-C2-D1-E1-F1-I1-K11-K12-L2-Z	53.7
326	A-B2-B3-C2-D1-E1-F1-I1-K2-J6-J7-L1-Z	53.3
328	A-B2-B3-C2-D1-E1-F1-I1-K2-K3-K12-L2-Z	50.4
329	A-B2-B3-C2-D1-E1-F1-G1-G3-G51-G52-I3-J1-J7-L1-Z	52.8
357	A-B2-B3-C2-D1-E1-F2-G4-G51-G52-I3-J1-J7-L1-Z	49.7
366	A-B2-B3-C2-D1-E1-F2-G4-G51-I2-J21-J22-J3-K4-K5-L1-Z	51.5
370	A-B2-C1-E1-F1-I1-K2-K3-K12-L2-Z	57.9
404	A-B2-C1-E1-F2-G4-G51-I2-J1-J7-L1-Z	56.3

TABLE 2 ENVIRONMENTAL DATA FOR ROUTES FILED IN THE CCN APPLICATION

Alternative Route Number	3	13	14	18	41	46	49	78	90	131	183
Length of alternative route	263,845	255,339	270,081	246,581	241,329	289,870	272,194	268,346	278,823	270,847	309,935
Length of alternative route (miles)	50 0	48.4	51.2	46 7	45.7	54.9	51.6	50.8	52 8	51 3	58.7
Length of route parallel to existing electric transmission lines	36,604	0	13,724	0	10,149	58,317	59,872	7,925	36,604	4,386	62,772
Length of route parallel to railroads	0	0	0	0	0	0	0	0	0	0	0
Length of route parallel to existing public roads/highways	15,673	16,481	15,673	16,481	16,481	8,038	8,038	16,481	21,077	20,723	26,470
Length of route parallel to pipelines	8,174	8,748	8,748	670	1,244	747	747	13,237	11,667	12,207	6,534
Length of route parallel to apparent property boundaries	24,489	55,190	57,898	53,125	44,559	78,943	53,521	51,080	10,697	41,397	19,841
Total length of route parallel to existing compatible rights-of-way	69,710	64,616	80,239	62,550	64,134	138,241	114,374	68,430	61,322	59,450	102,028
Number of habitable structures within 500 feet of the route centerline[1]	3	4	4	3	3	2	2	2	2	3	2
Number of parks or recreational areas within 1,000 feet of the route centerline[2]	0	0	0	0	0	0	0	0	0	0	0
Length of the route across parks/recreational areas	0	0	0	0	0	0	0	0	0	0	0
Length of route through commercial/industrial areas	14,249	13,699	13,977	11,888	11,337	10,422	10,409	12,038	14,496	13,877	16,364
Length of the route across cropland/hay meadow	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233
Length across rangeland pasture	232,330	215,803	235,767	207,862	198,704	237,747	231,348	228,465	242,690	229,067	271,636
Length of route across agricultural cropland with mobile irrigation systems	0	0	0	0	0	0	0	0	0	0	0
Length of route across upland woodlands	0	0	0	0	0	0	0	0	0	0	0
Length of route across riparian areas	14,607	19,658	17,673	19,869	24,327	34,721	26,789	21,094	18,739	22,139	18,374
Length of route across potential wetlands	1,343	4,861	1,347	5,644	5,644	5,528	2,319	5,433	1,595	4,461	2,279
Number of stream crossings by the route	13	18	18	15	14	16	20	13	37	39	32
Length of route parallel to streams (within 100 feet)	0	783	783	1,001	1,001	3,203	3,450	201	1,788	1,897	2,977
Length across lakes or ponds (open waters)	83	83	83	83	83	219	96	83	70	70	49
Number of known rare/unique plant locations within the right-of-way	1	1	1	1	1	4	3	3	0	0	0
Length of route through known habitat of endangered or threatened species	63	63	63	63	63	10,532	10,532	10,532	95	95	50
Number of recorded cultural resource sites crossed by the route	1	0	0	0	0	1	2	1	1	0	1
Number of recorded cultural resources within 1,000 feet of the route centerline	4	2	2	3	3	3	4	3	5	2	6
Length of route across areas of high archaeological/historical site potential	53,146	69,037	71,903	64,131	62,797	72,502	73,191	65,743	90,034	93,158	100,595
Number of private airstrips within 10,000 feet of the route centerline	0	0	0	0	0	0	0	0	0	0	0
Number of FAA-registered airports with at least one runway more than 3,200 feet in length within 20,000 feet of route centerline	0	0	0	0	0	1	1	1	0	0	0
Number of FAA-registered airports with no runway greater than 3,200 feet in length within 10,000 feet of the route centerline	0	0	0	0	0	0	0	0	0	0	0
Number of heliports located within 5,000 feet of the route centerline	0	0	0	0	0	0	0	0	0	0	0
Number of commercial AM radio transmitters located within 10,000 feet of the route centerline	0	0	0	0	0	0	0	0	0	0	0
Number of FM, microwave and other electronic installations within 2,000 feet of the route centerline	1	2	2	0	0	1	1	1	0	1	0
Number of U S or State Highway crossings by the route	3	3	3	3	3	3	3	3	3	3	2
Number of Farm to Market (F M), county roads, or other street crossings by the route	9	12	12	13	13	9	8	11	8	9	8
Estimated length of right-of-way within foreground visual zone of U S and State Highways	20,050	21,616	21,616	20,298	20,298	32,979	26,627	23,119	16,896	18,462	14,222
Estimated length of right-of-way within foreground visual zone of park/recreational areas	0	0	0	0	0	0	0	0	0	0	0

Note: All length measurements in feet All linear measurements were obtained from the National Agricultural Imagery Program digital ortho imagery flown in 2016-2017 with the exception of areas of high archaeological/historical site potential which were measured from USGS Topographic Quadrangles The aerial photograph has a provided accuracy of +/- 30 feet

[1]Structures normally inhabited by humans on a daily or regular basis Habitable structures include but are not limited to a single-family and multi-family dwellings and related structures, mobile homes, apartment buildings, commercial structures, industrial structures, churches, hospitals, nursing homes, and schools

[2]Defined as parks and recreational areas owned by a governmental body or an organized group, club, or church

[3]Believed to be systems no longer in use

* - Not included in length of route parallel to existing compatible rights-of-way

TABLE 2 ENVIRONMENTAL DATA FOR ROUTES FILED IN THE CCN APPLICATION

Alternative Route Number	280	281	282	292	293	296	297	310	320	324	325
Length of alternative route	267,199	273,212	257,698	249,191	263,933	263,481	240,433	281,790	235,181	249,471	283,722
Length of alternative route (miles)	50 6	51 7	48 8	47.2	50 0	49 9	45 5	53 4	44 5	47.2	53 7
Length of route parallel to existing electric transmission lines	22,117	8,393	36,604	0	13,724	54,446	0	59,872	10,149	64,596	58,317
Length of route parallel to railroads	0	0	0	0	0	0	0	0	0	0	0
Length of route parallel to existing public roads/highways	20,629	21,438	15,479	16,287	15,479	15,479	16,287	7,326	16,287	15,479	7,844
Length of route parallel to pipelines	8,174	8,174	8,174	8,748	8,748	13,110	670	747	1,244	5,606	747
Length of route parallel to apparent property boundaries	27,004	24,295	24,295	54,996	57,704	32,280	52,931	46,412	44,365	21,649	78,749
Total length of route parallel to existing compatible rights-of-way	62,888	47,264	69,516	64,422	80,045	95,343	62,356	106,748	63,940	94,861	138,047
Number of habitable structures within 500 feet of the route centerline[1]	38	38	38	39	39	39	38	38	38	38	37
Number of parks or recreational areas within 1,000 feet of the route centerline[2]	0	0	0	0	0	0	0	0	0	0	0
Length of the route across parks/recreational areas	0	0	0	0	0	0	0	0	0	0	0
Length of route through commercial/industrial areas	13,504	13,708	13,763	13,213	13,491	13,935	11,402	11,767	10,851	11,573	9,936
Length of the route across cropland/hay meadow	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233
Length across rangeland pasture	233,317	232,980	226,196	209,668	229,633	232,844	201,728	236,458	192,570	215,746	231,612
Length of route across agricultural cropland with mobile irrigation systems	0	0	0	0	0	0	0	0	0	0	0
Length of route across upland woodlands	0	0	0	0	0	0	0	0	0	0	0
Length of route across riparian areas	17,684	20,315	15,141	20,193	18,208	14,104	20,404	29,135	24,861	18,772	35,256
Length of route across potential wetlands	1,382	4,896	1,284	4,803	1,289	1,284	5,586	3,106	5,586	2,067	5,470
Number of stream crossings by the route	15	15	15	20	20	19	17	21	16	15	18
Length of route parallel to streams (within 100 feet)	0	0	0	783	783	581	1,001	1,584	1,001	799	3,203
Length across lakes or ponds (open waters)	80	80	80	80	80	80	80	92	80	80	215
Number of known rare/unique plant locations within the right-of-way	1	1	1	1	1	1	1	1	1	1	4
Length of route through known habitat of endangered or threatened species	63	63	63	63	63	63	63	63	63	63	10,532
Number of recorded cultural resource sites crossed by the route	1	1	1	0	0	0	0	1	0	0	1
Number of recorded cultural resources within 1,000 feet of the route centerline	2	2	2	0	0	0	1	2	1	1	1
Length of route across areas of high archaeological/historical site potential	53,412	50,546	53,412	69,303	72,170	68,262	64,397	65,523	63,063	62,021	72,768
Number of private airstrips within 10,000 feet of the route centerline	0	0	0	0	0	0	0	0	0	0	0
Number of FAA-registered airports with at least one runway more than 3,200 feet in length within 20,000 feet of route centerline	0	0	0	0	0	0	0	0	0	0	1
Number of FAA-registered airports with no runway greater than 3,200 feet in length within 10,000 feet of the route centerline	0	0	0	0	0	0	0	0	0	0	0
Number of heliports located within 5,000 feet of the route centerline	0	0	0	0	0	0	0	0	0	0	0
Number of commercial AM radio transmitters located within 10,000 feet of the route centerline	0	0	0	0	0	0	0	0	0	0	0
Number of FM, microwave and other electronic installations within 2,000 feet of the route centerline	1	1	1	2	2	4	0	0	0	2	1
Number of U S or State Highway crossings by the route	3	3	3	3	3	3	3	3	3	3	3
Number of Farm to Market (F M), county roads, or other street crossings by the route	9	9	9	12	12	9	13	10	13	10	9
Estimated length of right-of-way within foreground visual zone of U S and State Highways	20,050	20,050	20,050	21,616	21,616	21,616	20,298	23,806	20,298	20,298	32,979
Estimated length of right-of-way within foreground visual zone of park/recreational areas	0	0	0	0	0	0	0	0	0	0	0

Note: All length measurements in feet All linear measurements were obtained from the National Agricultural Imagery Program digital ortho imagery flown in 2016-2017 with the exception of areas of high archaeological/historical site potential which were measured from USGS Topographic Quadrangles The aerial photograph has a provided accuracy of +/- 30 feet

[1]Structures normally inhabited by humans on a daily or regular basis Habitable structures include but are not limited to a single-family and multi-family dwellings and related structures, mobile homes, apartment buildings, commercial structures, industrial structures, churches, hospitals, nursing homes, and schools
[2]Defined as parks and recreational areas owned by a governmental body or an organized group, club, or church

[3]Believed to be systems no longer in use

* - Not included in length of route parallel to existing compatible rights-of-way

TABLE 2 ENVIRONMENTAL DATA FOR ROUTES FILED IN THE CCN APPLICATION

Alternative Route Number	326	328	329	357	366	370	404
Length of alternative route	281,677	266,046	278,897	262,198	272,139	305,532	297,334
Length of alternative route (miles)	53 3	50 4	52 8	49.7	51 5	57.9	56 3
Length of route parallel to existing electric transmission lines	23,841	59,872	0	7,925	72,520	59,872	18,074
Length of route parallel to railroads	0	0	0	0	0	0	0
Length of route parallel to existing public roads/highways	16,805	7,844	16,805	16,287	15,479	21,892	30,336
Length of route parallel to pipelines	747	747	670	13,237	18,173	3,460	16,524
Length of route parallel to apparent property boundaries	53,327	53,327	72,985	50,886	19,604	73,073	62,066
Total length of route parallel to existing compatible rights-of-way	87,111	114,180	82,928	68,236	100,741	135,522	91,161
Number of habitable structures within 500 feet of the route centerline[1]	37	37	37	37	37	66	66
Number of parks or recreational areas within 1,000 feet of the route centerline[2]	0	0	0	0	0	0	0
Length of the route across parks/recreational areas	0	0	0	0	0	0	0
Length of route through commercial/industrial areas	10,313	9,923	11,791	11,552	11,975	8,577	9,907
Length of the route across cropland/hay meadow	1,233	1,233	1,233	1,233	1,233	7,177	7,177
Length across rangeland pasture	236,777	225,214	238,868	222,330	237,223	258,816	247,649
Length of route across agricultural cropland with mobile irrigation systems	0	0	0	0	0	3,043	3,043
Length of route across upland woodlands	0	0	0	0	0	0	0
Length of route across riparian areas	27,508	27,324	22,183	21,629	19,771	24,584	23,121
Length of route across potential wetlands	5,766	2,261	4,741	5,375	1,856	3,253	6,367
Number of stream crossings by the route	18	22	18	15	13	26	18
Length of route parallel to streams (within 100 feet)	3,125	3,450	2,866	201	0	4,449	1,201
Length across lakes or ponds (open waters)	80	92	80	80	80	83	70
Number of known rare/unique plant locations within the right-of-way	3	3	3	3	3	1	1
Length of route through known habitat of endangered or threatened species	10,532	10,532	10,532	10,532	10,532	52	52
Number of recorded cultural resource sites crossed by the route	1	2	1	1	1	1	0
Number of recorded cultural resources within 1,000 feet of the route centerline	1	2	1	1	1	1	0
Length of route across areas of high archaeological/historical site potential	64,957	73,458	72,332	66,009	63,633	49,928	41,145
Number of private airstrips within 10,000 feet of the route centerline	0	0	0	0	0	0	0
Number of FAA-registered airports with at least one runway more than 3,200 feet in length within 20,000 feet of route centerline	1	1	1	1	1	2	2
Number of FAA-registered airports with no runway greater than 3,200 feet in length within 10,000 feet of the route centerline	0	0	0	0	0	0	0
Number of heliports located within 5,000 feet of the route centerline	0	0	0	0	0	0	0
Number of commercial AM radio transmitters located within 10,000 feet of the route centerline	0	0	0	0	0	1	1
Number of FM, microwave and other electronic installations within 2,000 feet of the route centerline	1	1	1	1	3	0	0
Number of U S or State Highway crossings by the route	3	3	3	3	3	3	3
Number of Farm to Market (F M), county roads, or other street crossings by the route	8	8	11	11	8	16	19
Estimated length of right-of-way within foreground visual zone of U S and State Highways	23,119	26,627	23,119	23,119	23,119	28,636	25,128
Estimated length of right-of-way within foreground visual zone of park/recreational areas	0	0	0	0	0	0	0

Note: All length measurements in feet All linear measurements were obtained from the National Agricultural Imagery Program digital ortho imagery flown in 2016-2017 with the exception of areas of high archaeological/historical site potential which were measured from USGS Topographic Quadrangles The aerial photograph has a provided accuracy of +/- 30 feet

[1]Structures normally inhabited by humans on a daily or regular basis Habitable structures include but are not limited to a single-family and multi-family dwellings and related structures, mobile homes, apartment buildings, commercial structures, industrial structures, churches, hospitals, nursing homes, and schools

[2]Defined as parks and recreational areas owned by a governmental body or an organized group, club, or church

[3]Believed to be systems no longer in use

* - Not included in length of route parallel to existing compatible rights-of-way

Joint Application of Oncor Electric Delivery Company LLC and AEP Texas Inc. to Amend Their Certificates of Convenience and Necessity for a Proposed Double-Circuit 345-kV Transmission Line in Pecos, Reeves, and Ward Counties, Texas (Sand Lake - Solstice CCN)

PUBLIC UTILITY COMMISSION OF TEXAS (PUC) DOCKET NO. 48785

Landowner

This notice is provided to notify you of the intent of Oncor Electric Delivery Company LLC ("Oncor") and AEP Texas Inc. ("AEP") to construct a new double-circuit 345 kilovolt ("kV") electric transmission line to be built on steel towers between the Oncor Sand Lake Switch, to be located approximately six miles northeast of the City of Pecos on the northwest side of Farm-to-Market Road ("FM")3398 in Ward County and the AEP Texas Solstice Switch, located along the north side of Interstate Highway ("IH")10 approximately 2.5 miles east of the Pecos/Reeves County Line, in Pecos County. The proposed transmission line will be approximately 44.5 – 58.7 miles in length, depending upon the route approved by the Public Utility Commission of Texas ("PUC"). The estimated cost of this project is $125,931,000 but may vary depending upon the route approved by the PUC.

Your land may be directly affected by this docket. If one of the applicant's routes is approved by the PUC, the applicants will have the right to build a facility which may directly affect your land. This docket will not determine the value of your land or the value of an easement if one is needed by the applicants to build the facility. Persons with questions about the transmission line may contact Chris Reily of Oncor at (214) 486-4717.

A detailed routing map may be reviewed at the following locations:

Display Location	Address
Reeves County Courthouse	100 E. 4th St., Pecos, TX 79722
Ward County Courthouse	400 S. Allen, Suite 101, Monahans, TX 79756
Pecos County Courthouse	103 West Callaghan, Fort Stockton, TX 79735

All routes and route segments included in this notice are available for selection and approval by the Public Utility Commission of Texas.

The enclosed brochure entitled "Landowners and Transmission Line Cases at the PUC" provides basic information about how you may participate in this docket, and how you may contact the PUC. Please read this brochure carefully. The brochure includes sample forms for making comments and for making a request to intervene as a party in this docket. ***The only way to fully participate in the PUC's decision on where to locate the transmission line is to intervene in the docket. It is important for an affected person to intervene because the utility is not obligated to keep affected persons informed of the PUC's proceedings and cannot predict which route may or may not be approved by the PUC.***

ATTACHMENT NO. 13

In addition to the contacts listed in the brochure, you may call the PUC's Customer Assistance Hotline at (888) 782-8477. Hearing and speech-impaired individuals with text telephones (TTY) may contact the PUC's Customer Assistance Hotline at (512) 936-7136 or toll free at (800) 735-2989. If you wish to participate in this proceeding by becoming an intervenor, the deadline for intervention in the proceeding is **December 27, 2018**, which is 45 days after filing of the application, and the PUC should receive a letter from you requesting intervention by that date. Mail the request for intervention and 10 copies of the request to:

Public Utility Commission of Texas
Central Records
Attn: Filing Clerk
1701 N. Congress Avenue
P. O. Box 13326
Austin, Texas 78711-3326

Persons who wish to intervene in the docket must also mail a copy of their request for intervention to all parties in the docket and all persons that have pending motions to intervene, at or before the time the request for intervention is mailed to the PUC. In addition to the intervention deadline, other important deadlines may already exist that affect your participation in this docket. You should review the orders and other filings already made in the docket. The enclosed brochure explains how you can access these filings.

Enclosures:

- Route Link Descriptions and Maps
- Landowners and Transmission Line Cases at the PUC
- Request to Intervene Form
- Comment Form
- Landowner's Bill of Rights

Table 1. COMPOSITION OF ROUTES FILED IN THE CCN APPLICATION

Route	Link Sequence
3	A-B1-C3-C2-D2-E2-F4-G6-H2-J22-J3-K4-K5-L1-Z
13	A-B1-C3-C2-D2-E2-F4-H1-I3-J1-J7-L1-Z
14	A-B1-C3-C2-D2-E2-F4-H1-I3-J1-J5-J8-K5-L1-Z
18	A-B1-C3-C2-D2-F3-G2-G3-G51-G52-I3-J1-J7-L1-Z
41	A-B1-C3-C2-D2-F3-G4-G51-I2-J1-J7-L1-Z
46	A-B1-C3-C2-D1-E1-F1-I1-K11-K12-L2-Z
49	A-B1-C3-C2-D1-E1-F1-I1-K2-K3-K12-L2-Z
78	A-B1-C3-C2-D1-E1-F2-G4-G51-G52-I3-J1-J7-L1-Z
90	A-B1-C4-D31-E4-D42-F5-H2-J22-J3-K4-K5-L1-Z
131	A-B1-C4-D31-D32-E3-F4-H1-I3-J1-J7-L1-Z
183	A-B1-C4-D41-D42-F5-H2-J22-J3-K4-K5-L1-Z
280	A-B2-B3-C2-D2-E2-F4-G6-H2-J22-J3-J4-J8-K5-L1-Z
281	A-B2-B3-C2-D2-E2-F4-G6-H2-J22-J3-J4-J5-J7-L1-Z
282	A-B2-B3-C2-D2-E2-F4-G6-H2-J22-J3-K4-K5-L1-Z
292	A-B2-B3-C2-D2-E2-F4-H1-I3-J1-J7-L1-Z
293	A-B2-B3-C2-D2-E2-F4-H1-I3-J1-J5-J8-K5-L1-Z
296	A-B2-B3-C2-D2-E2-F4-H1-I3-J21-J22-J3-K4-K5-L1-Z
297	A-B2-B3-C2-D2-F3-G2-G3-G51-G52-I3-J1-J7-L1-Z
310	A-B2-B3-C2-D2-F3-G2-G1-I1-K2-K3-K12-L2-Z
320	A-B2-B3-C2-D2-F3-G4-G51-I2-J1-J7-L1-Z
324	A-B2-B3-C2-D2-F3-G4-G51-I2-J21-J22-J3-K4-K5-L1-Z
325	A-B2-B3-C2-D1-E1-F1-I1-K11-K12-L2-Z
326	A-B2-B3-C2-D1-E1-F1-I1-K2-J6-J7-L1-Z
328	A-B2-B3-C2-D1-E1-F1-I1-K2-K3-K12-L2-Z
329	A-B2-B3-C2-D1-E1-F1-G1-G3-G51-G52-I3-J1-J7-L1-Z
357	A-B2-B3-C2-D1-E1-F2-G4-G51-G52-I3-J1-J7-L1-Z
366	A-B2-B3-C2-D1-E1-F2-G4-G51-I2-J21-J22-J3-K4-K5-L1-Z
370	A-B2-C1-E1-F1-I1-K2-K3-K12-L2-Z
404	A-B2-C1-E1-F2-G4-G51-I2-J1-J7-L1-Z

Link A

From the Sand Lake Switch, **Link A** proceeds in a southeasterly direction for approximately 2,400 feet to the intersection of **Links A**, **B1**, and **B2**. **Link A** crosses Farm-to-Market (FM) 3398, a natural gas pipeline, and two existing transmission lines.

Link B1

From the intersection of **Links A**, **B1**, and **B2**, **Link B1** proceeds in a northeasterly direction for approximately 3,000 feet to an angle point. This segment of **Link B1** crosses an existing transmission line, two crude oil pipelines, and FM 516. From this angle point, **Link B1** continues in a southeasterly direction for approximately 7,100 feet to the intersection of **Links B1**, **C3**, and **C4**. This segment of **Link B1** crosses two existing transmission lines.

Link B2

From the intersection of **Links A**, **B1**, and **B2**, **Link B2** proceeds in a southwesterly direction for approximately 2,300 feet to an angle point. This segment of **Link B2** crosses a natural gas pipeline. From this angle point, **Link B2** continues in a southeasterly direction, for approximately 4,300 feet to the intersection of **Links B2**, **B3**, and **C1**. This segment of **Link B2** crosses a natural gas pipeline, County Road (CR) 1010, CR 155, an existing transmission line, Main Line Canal, and CR 148.

Link B3

From the intersection of **Links B2**, **B3**, and **C1**, **Link B3** proceeds in a southeasterly direction, parallel to a natural gas pipeline, for approximately 2,500 feet to the intersection of **Links B3**, **C2**, and **C3**. This segment of **Link B3** crosses a refined products pipeline and a crude oil pipeline.

Link C1

From the intersection of **Links B2**, **B3**, and **C1**, **Link C1** proceeds in a southwesterly direction for approximately 3,200 feet to an angle point. This segment of **Link C1** crosses a natural gas pipeline, FM 873, a refined products pipeline, and a crude oil pipeline. From this angle point, **Link C1** proceeds in a southwesterly direction for approximately 1,100 feet to an angle point. From this angle point, **Link C1** proceeds in a southwesterly direction for approximately 4,200 feet to an angle point. From this angle point, **Link C1** proceeds in a westerly direction for approximately 8,500 feet to an angle point. This segment of **Link C1** crosses Lateral Number One, the Pecos River (Reeves and Ward counties boundary), two existing transmission lines, and FM 1216. From this angle point, **Link C1** proceeds in a west/southwesterly direction for approximately 7,600 feet to an angle point. This segment of **Link C1** crosses US 285, a crude oil pipeline, and a natural gas pipeline. From this angle point, **Link C1** proceeds in a southerly direction for approximately 2,200 feet to an angle point. From this angle point, **Link C1** proceeds in a south/southeasterly direction, parallel to CR 402, for approximately 2,000 feet to an angle point. From this angle point, **Link C1** proceeds in a west/southwesterly direction for approximately 28,600 feet to an angle point. This segment of **Link C1** crosses CR 402, an abandoned railroad terrace, FM 2119, CR 408, an existing transmission line, a natural gas liquids pipeline, a crude oil pipeline, and two natural gas pipelines. From this angle point, **Link C1** proceeds in a south/southwesterly direction for approximately 1,100 feet to an angle point. From this angle point, **Link C1** proceeds in a west/southwesterly direction, parallel to CR 404, for approximately 5,300 feet to an angle point. From this angle point, **Link C1** proceeds in a southwesterly direction for approximately 1,100 feet to an angle point. This segment of **Link C1** crosses CR 409. From this angle point, **Link C1** proceeds in a west/southwesterly direction for approximately 4,500 feet to an angle point. This segment of **Link C1** crosses an existing transmission line. From this angle point, **Link C1** proceeds in a south/southeasterly direction, parallel to an existing transmission line, for approximately 2,000 feet to an angle point. From this angle point, **Link C1** proceeds in a south/southeasterly direction for approximately 500 feet to an angle point. This segment of **Link C1** crosses a railroad terrace, a natural gas pipeline, and IH 20. From this angle point, **Link C1** proceeds in a south/southeasterly direction for approximately 1,000 feet to an angle point. From this angle point, **Link**

C1 proceeds in a south/southwesterly direction for approximately 9,400 feet to an angle point. This segment of **Link C1** crosses two natural gas pipelines. From this angle point, **Link C1** proceeds in a south/southeasterly direction for approximately 2,200 feet to an angle point. This segment of **Link C1** crosses two natural gas pipelines. From this angle point, **Link C1** proceeds in a south/southwesterly direction for approximately 5,300 feet to an angle point. This segment of **Link C1** crosses CR 211. From this angle point, **Link C1** proceeds in an east/southeasterly direction for approximately 3,900 feet to an angle point. This segment of **Link C1** crosses a natural gas pipeline. From this angle point, **Link C1** proceeds in a south/southeasterly direction for approximately 2,400 feet to an angle point. This segment of **Link C1** crosses CR 339. From this angle point, **Link C1** proceeds in an east/southeasterly direction for approximately 36,700 feet to the intersection of **Links C1**, **D1**, and **E1**. This segment of **Link C1** crosses FM 869, a railroad terrace, SH 17, three natural gas pipelines, Salt Draw, CR 118, two crude oil pipelines, and a natural gas liquids pipeline.

Link C2

From the intersection of **Links B3**, **C2**, and **C3**, **Link C2** proceeds in a southwesterly direction for approximately 5,500 feet to an angle point. This segment of **Link C2** crosses a natural gas pipeline and FM 873. From this angle point, **Link C2** proceeds in a southeasterly direction for approximately 14,400 feet to an angle point. This segment of **Link C2** crosses CR 140. From this angle point, **Link C2** proceeds in a south/southeasterly direction for approximately 3,500 feet to an angle point. This segment of **Link C2** crosses a railroad terrace and Business IH 20. From this angle point, **Link C2** proceeds in a south/southeasterly direction for approximately 4,400 feet to an angle point. From this angle point, **Link C2** proceeds in a southerly direction for approximately 1,200 feet to an angle point. This segment of **Link C2** crosses the Pecos River (Reeves and Ward counties boundary). From this angle point, **Link C2** proceeds in a southeasterly direction for approximately 1,200 feet to an angle point. From this angle point, **Link C2** proceeds in a south/southeasterly direction for approximately 3,300 feet to an angle point. This segment of **Link C2** crosses a natural gas pipeline and IH 20. From this angle point, **Link C2** proceeds in a south/southwesterly direction for approximately 1,200 feet to the intersection **Links C2, D1**, and **D2**.

Link C3 (Bi-directional Link)

From the intersection of **Links B1**, **C3**, and **C4**, **Link C3** proceeds in a southwesterly direction for approximately 5,300 feet to the intersection of **Links B2**, **C2**, and **C3**. This segment crosses FM 516, three crude oil pipelines, a refined products pipeline, Main Line Canal, and CR 148.

Link C4

From the intersection of **Links B1**, **C3**, and **C4**, **Link C4** proceeds in a northeasterly direction for 1,200 feet to an angle point. This segment of **Link C4** crosses Cedarvale Canal and CR 149. From this angle point, **Link C4** proceeds in an east/northeasterly direction for approximately 6,400 feet to an angle point. This segment of **Link C4** crosses a natural gas pipeline and an existing transmission line. From this angle point, **Link C4** proceeds in a southeasterly direction for 14,500 feet to the intersection of **Links C4**, **D31**, and **D41**. This segment of **Link C4** crosses RM 2355, a refined products pipeline, and a crude oil pipeline.

Link D1

From the intersection of **Links C2**, **D1**, and **D2**, **Link D1** proceeds in a southwesterly direction for approximately 8,700 feet to an angle point. This segment of **Link D1** crosses two natural gas pipelines. From this angle point, **Link D1** proceeds in a southerly direction for approximately 5,700 feet to an angle point. This segment of **Link D1** crosses a natural gas pipeline. From this angle point, **Link D1** proceeds in a south/southwesterly direction for approximately 1,200 feet to an angle point. This segment of **Link D1** crosses FM 1450 and an existing transmission line. From this angle point, **Link D1** proceeds in a southwesterly direction for approximately 3,300 feet to an angle point. From this angle point, **Link D1** proceeds in a south/southwesterly direction for approximately 2,200 feet to an angle point. This segment of **Link D1** crosses a crude oil pipeline. From this angle point, **Link D1** proceeds in a southwesterly direction for approximately 4,300 feet to an angle point. This segment of **Link D1** crosses a natural gas pipeline and US 285. From this angle point, **Link D1** proceeds in a westerly direction for approximately 5,000 feet to an angle point. This segment of **Link D1** crosses a crude oil pipeline. From this angle point, **Link D1** proceeds in a southwesterly direction for approximately 3,300 feet to an angle point. From this angle point, **Link D1** proceeds in a westerly direction for approximately 5,600 feet to an angle point. This segment of **Link D1** crosses a natural gas pipeline. From this angle point, **Link D1** proceeds in a south/southwesterly direction for approximately 15,000 feet to an angle point. This segment of **Link D1** crosses a crude oil pipeline, an existing transmission line, nine natural gas pipelines, and Salt Draw. From this angle point, **Link D1** proceeds in a southeasterly direction for approximately 2,100 feet to the intersection of **Links C1**, **D1**, and **E1**.

Link D2

From the intersection of **Links C2**, **D1**, and **D2**, **Link D2** proceeds in a south/southwesterly direction for approximately 2,000 feet to an angle point. From this angle point, **Link D2** proceeds in a south/southeasterly direction for approximately 10,700 feet to an angle point. This segment of **Link D2** crosses two natural gas pipelines. From this angle point, **Link D2** proceeds in an east/southeasterly direction for approximately 6,600 feet to the intersection of **Links D2**, **E2**, and **F3**. This segment of **Link D2** crosses two natural gas pipelines and Toyah Creek.

Link D31

From the intersection of **Links C4**, **D31**, and **D41**, **Link D31** proceeds in a southeasterly direction for approximately 7,000 feet to an angle point. This segment of **Link D31** crosses an existing transmission line. From this angle point, **Link D31** proceeds in a south/southeasterly direction for approximately 900 feet to an angle point. This segment of **Link D31** crosses a railroad terrace and Business IH 20. From this angle point, **Link D31** proceeds in a southeasterly direction for approximately 3,400 feet to an angle point. This segment of **Link D31** crosses IH 20. From this angle point, **Link D31** proceeds in an east/southeasterly direction for approximately 20,200 feet to an angle point. This segment of **Link D31** crosses Rock Quarry Draw. From this angle point, **Link D31** proceeds in a south/southwesterly direction for approximately 17,900 feet to the intersection of **Links D31**, **D32**, and **E4**. This segment of **Link D31** crosses the Pecos River (Reeves and Ward counties boundary) and five natural gas pipelines.

Link D32

From the intersection of **Links D31**, **D32**, and **E4**, **Link D32** proceeds in a south/southwesterly direction for approximately 7,300 feet to the convergence of **Link D32** and **Link E3**. **Link D32** crosses a natural gas pipeline.

Link D41

From the intersection of **Links C4**, **D31**, and **D41**, **Link D41** proceeds in a northeasterly direction for approximately 4,700 feet to an angle point. This segment of **Link D41** crosses a crude oil pipeline and a refined products pipeline. From this angle point, **Link D41** proceeds in an east/northeasterly direction for approximately 1,200 feet to an angle point. From this angle point, **Link D41** proceeds in a northeasterly direction, parallel to an existing transmission line, for approximately 6,200 feet to an angle point. This segment of **Link D41** crosses two natural gas pipelines. From this angle point, **Link D41** proceeds in an east/northeasterly direction, parallel to an existing transmission line, for approximately 4,100 feet to an angle point. This segment of **Link D41** crosses two natural gas pipelines. From this angle point, **Link D41** proceeds in a northeasterly direction, parallel to an existing transmission line, for approximately 1,200 feet to an angle point. From this angle point, **Link D41** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 900 feet to an angle point. From this angle point, **Link D41** proceeds in an east/northeasterly direction for approximately 13,800 feet to an angle point. This segment of **Link D41** crosses a natural gas pipeline. From this angle point, **Link D41** proceeds in a southeasterly direction for approximately 6,000 feet to an angle point. This segment of **Link D41** crosses an existing transmission line, two natural gas pipelines, and a crude oil pipeline. From this angle point, **Link D41** proceeds in a south/southeasterly direction for approximately 6,000 feet to an angle point. This segment of **Link D41** crosses two natural gas pipelines, a railroad terrace, and IH 20. From this angle point, **Link D41** proceeds in southeasterly direction for approximately 8,900 feet to an angle point. This segment of **Link D41** crosses a natural gas pipeline twice at separate locations. From this angle point, **Link D41** proceeds in a southerly direction for approximately 12,600 feet to an angle point. This segment of **Link D41** crosses a refined products pipeline and a natural gas pipeline. From this angle point, **Link D41** proceeds in a southwesterly direction for approximately 10,300 feet to an angle point. This segment of **Link D41** crosses the Pecos River (Reeves and Ward counties boundary). From this angle point, **Link D41** proceeds in a south/southwesterly direction for approximately 9,100 feet to an angle point. This segment of **Link D41** crosses a natural gas pipeline. From this angle point, **Link D41** proceeds in a south/southwesterly direction for approximately 1,100 feet to an angle point. From this angle point, **Link D41** proceeds in a south/southwesterly direction for approximately 5,500 feet to the intersection of **Link D41**, **D42**, and **E4**. This segment of **Link D41** crosses two natural gas pipelines.

<u>Link D42</u>

From the intersection of **Link D41**, **D42**, and **E4**, **Link D42** proceeds in a south/southwesterly direction for approximately 1,000 feet to the convergence of **Link D42** and **Link F5**. This segment of **Link D42** crosses two natural gas pipelines and an existing transmission line.

<u>Link E1</u>

Form the intersection of **Links C1**, **D1**, and **E1**, **Link E1** proceeds in a southeasterly direction for approximately 5,500 feet to the intersection of **Links E1**, **F1**, and **F2**. This segment of **Link E1** crosses a natural gas pipeline.

<u>**Link E2 (Bi-directional Link)**</u>

From the intersection of **Links E2**, **E3**, and **F4**, **Link E2** proceeds in a west/northwesterly direction for approximately 4,600 feet to an angle point. From this angle point, **Link E2** proceeds in a northwesterly direction for approximately 4,200 feet to an angle point. This segment of **Link E2** crosses CR 105 and a natural gas pipeline. From this angle point, **Link E2** proceeds in a westerly direction for approximately 3,600 feet to the intersection of **Links D2**, **E2**, and **F3**. This segment of **Link E2** crosses two crude oil pipelines.

<u>Link E3</u>

From the convergence of **Link D32** to **Link E3**, **Link E3** proceeds in a west/southwesterly direction, parallel to an existing transmission line, for approximately 4,400 feet to an angle point. This segment of **Link E3** crosses a natural gas pipeline. From this angle point, **Link E3** proceeds in a west/northwesterly direction for approximately 4,200 feet to the intersection of **Links E2**, **E3**, and **F4**.

<u>**Link E4 (Bi-directional Link)**</u>

From the intersection of **Links D41**, **D42**, and **E4**, **Link E4** proceeds in a west/northwesterly direction for approximately 2,900 feet to an angle point. From this angle point, **Link E4** proceeds in a westerly direction for approximately 2,200 feet to an angle point. From this angle point, **Link E4** proceeds in a west/northwesterly direction for approximately 5,900 feet to the intersection of **Links D31**, **D32**, and **E4**. This segment of **Link E4** crosses two natural gas pipelines.

<u>Link F1</u>

From the intersection of **Links E1**, **F1**, and **F2**, **Link F1** proceeds in a south/southwesterly direction for approximately 4,200 feet to an angle point. This segment of **Link F1** crosses a natural gas liquids pipeline and a crude oil pipeline. From this angle point, **Link F1** proceeds in a southerly direction for approximately 1,200 feet to an angle point. From this angle point, **Link F1** proceeds in a south/southwesterly direction for approximately 15,500 feet to the intersection of **Links F1**, **G1**, and **I1**. This segment of **Link F1** crosses Toyah Creek and a crude oil pipeline.

<u>Link F2</u>

From the intersection of **Links E1**, **F1**, and **F2**, **Link F2** proceeds in an east/southeasterly direction for approximately 2,800 feet to an angle point. This segment of **Link F2** crosses an existing transmission line. From this angle point, **Link F2** proceeds in a south/southeasterly direction for approximately 7,900 feet to an angle point. This segment of **Link F2** crosses Toyah Creek. From this angle point, **Link F2** proceeds in an east/southeasterly direction for approximately 2,200 feet to an angle point. From this angle point, **Link F2** proceeds in a southerly direction for approximately 1,200 feet to an angle point. From this angle point, **Link F2** proceeds in a southeasterly direction for approximately 15,900 feet to the intersection of **Links F2**, **F3**, **G2**, and **G4**. This segment of **Link F2** crosses a crude oil pipeline and a natural gas liquids pipeline.

<u>Link F3</u>

From the intersection of **Links D2**, **E2**, and **F3**, **Link F3** proceeds in a south/southwesterly direction for approximately 16,300 feet to an angle point. This segment of **Link F3** crosses an existing transmission line, FM 1450, four natural gas pipelines, and three crude oil pipelines. From this angle point, **Link F3** proceeds in a west/southwesterly direction for approximately 3,000 feet to an angle point. From this angle point, **Link F3** proceeds in a south/southwesterly direction for approximately 9,700 feet to an angle point. This segment of **Link F3** crosses five natural gas pipelines. From this angle point, **Link F3** proceeds in a southwesterly direction for approximately 5,500 feet to an angle point. This segment of **Link F3** crosses US 285 and CR 113. From this angle point, **Link F3** proceeds in a southerly direction for approximately 15,100 feet to the intersection of **Links F2**, **F3**, **G2**, and **G4**. This segment of **Link F3** crosses CR 113, a crude oil pipeline, and a natural gas liquids pipeline.

<u>Link F4</u>

From the intersection of **Links E2**, **E3**, and **F4**, **Link F4** proceeds in a south/southwesterly direction for approximately 2,700 feet to an angle point. This segment of **Link F4** crosses an existing transmission line and FM 1450. From this angle point, **Link F4** proceeds in a southerly direction for approximately 3,400 feet to an angle point. From this angle point, **Link F4** proceeds in a south/southwesterly direction for approximately 7,000 feet to an angle point. This segment of **Link F4** crosses two natural gas pipelines and a crude oil pipeline. From this angle point, **Link F4** proceeds in a southeasterly direction for approximately 5,900 feet to the intersection of **Links F4**, **G6**, and **H1**.

<u>Link F5</u>

From the convergence of **Link D42** and **Link F5**, **Link F5** proceeds in a southeasterly direction for approximately 10,100 feet to an angle point. This segment of **Link F5** crosses a natural gas pipeline. From this angle point, **Link F5** proceeds in a south/southwesterly direction for approximately 11,600 feet to an angle point. This segment of **Link F5** crosses five natural gas pipelines, CR 104, FM 1450, and CR 103. From this angle point, **Link F5** proceeds in a west/southwesterly direction for approximately 4,800 feet to an angle point. This segment of **Link F5** crosses a natural gas pipeline. From this angle point, **Link F5** proceeds in a south/southwesterly direction for approximately 3,700 feet to an angle point. From this angle point, **Link F5** proceeds in a westerly direction for approximately 3,600 feet to an angle point. This segment of **Link F5** crosses two natural gas pipelines. From this angle point, **Link F5** proceeds in a westerly direction for approximately 1,300 feet to the intersection of **Links F5**, **G6**, and **H2**. This segment of **Link F5** crosses a crude oil pipeline.

Link G1 (Bi-directional Link)

From the intersection of **Links F1**, **G1**, and **I1**, **Link G1** proceeds in an east/southeasterly direction for approximately 1,000 feet to an angle point. From this angle point, **Link G1** proceeds in an easterly direction for approximately 9,200 feet to an angle point. This segment of **Link G1** crosses a crude oil pipeline. From this angle point, **Link G1** proceeds in an east/northeasterly direction for approximately 2,200 feet to an angle point. From this angle point, **Link G1** proceeds in an easterly direction for approximately 6,600 feet to an angle point. From this angle point, **Link G1** proceeds in an east/southeasterly direction for approximately 2,400 feet to an angle point. From this angle point, **Link G1** proceeds in an easterly direction for approximately 5,900 feet to intersection of **Links G1**, **G2**, and **G3**.

Link G2

From the intersection of **Links F2**, **F3**, **G2**, and **G4**, **Link G2** proceeds in a southerly direction for approximately 2,200 feet to the intersection of **Links G1**, **G2**, and **G3**. **Link G2** crosses an existing transmission line and a crude oil pipeline.

Link G3 (Bi-directional Link)

From the intersection of **Links G1**, **G2**, and **G3**, **Link G3** proceeds in an easterly direction for approximately 1,200 feet to the intersection of **Links G3**, **G4**, and **G51**. **Link G3** crosses an existing transmission line.

Link G4

From the intersection of **Links F2**, **F3**, **G2**, and **G4**, **Link G4** proceeds in a south/southeasterly direction for approximately 2,600 feet to the intersection of **Links G3**, **G4**, and **G51**, and **I2**. **Link G4** crosses a crude oil pipeline.

Link G51 (Bi-directional Link)

From the intersection of **Links G51**, **G52**, and **I2**, **Link G51** proceeds in a westerly direction for approximately 3,600 feet to the intersection of **Links G3**, **G4**, and **G51**.

Link G52 (Bi-directional Link)

From the intersection of **Links G52**, **H1**, and **I3**, **Link G52** proceeds in a westerly direction for approximately 7,300 feet to the intersection of **Links G51**, **G52**, and **I2**.

Link G6

From the intersection of **Links F4**, **G6**, and **H1**, **Link G6** proceeds in a southeasterly direction for approximately 700 feet to an angle point. From this angle point, **Link G6** proceeds in a south/southeasterly direction for approximately 2,000 feet to an angle point. This segment of **Link G6** crosses two natural gas pipelines. From this angle point, **Link G6** proceeds in an east/southeasterly direction for approximately 10,200 feet to the intersection of **Links F5**, **G6**, and **H2**. This segment of **Link G6** crosses a natural gas pipeline.

Link H1

From the intersection of **Links F4**, **G6**, and **H1**, **Link H1** proceeds in a south/southwesterly direction for approximately 2,100 feet to an angle point. This segment of **Link H1** crosses two natural gas pipelines. From this angle point, **Link H1** proceeds in a southwesterly direction for approximately 3,000 feet to an angle point. From this angle point, **Link H1** proceeds in a southerly direction for approximately 9,600 feet to an angle point. This segment of **Link H1** crosses three natural gas pipelines. From this angle point, **Link H1** proceeds in a south/southeasterly direction for approximately 2,300 feet to an angle point. From this angle point, **Link H1** proceeds in a southerly direction for approximately 12,000 feet to an angle point.

This segment of **Link H1** crosses two crude oil pipelines, a natural gas liquids pipeline, and two natural gas pipelines. From this angle point, **Link H1** proceeds in a westerly direction for approximately 2,400 feet to an angle point. From this angle point, **Link H1** proceeds in a west/southwesterly direction for approximately 2,000 feet to an angle point. This segment of **Link H1** crosses a crude oil pipeline and US 285. From this angle point, **Link H1** proceeds in a west/northwesterly direction for approximately 2,200 feet to an angle point. From this angle point, **Link H1** proceeds in a westerly direction for approximately 6,700 feet to the intersection of **Links G52**, **H1**, and **I3**.

<u>Link H2</u>

From the intersection of **Links F5**, **G6**, and **H2**, **Link H2** proceeds in a southerly direction for approximately 12,800 feet to an angle point. This segment of **Link H2** crosses three natural gas pipelines, two crude oil pipelines, and a natural gas liquid pipeline. From this angle point, **Link H2** proceeds in a south/southwesterly direction for approximately 2,200 feet to an angle point. From this angle point, **Link H2** proceeds in a southerly direction for approximately 26,800 feet to an angle point. This segment of **Link H2** crosses CR 109 and four natural gas pipelines. From this angle point, **Link H2** proceeds in a southwesterly direction for approximately 4,200 feet to an angle point. From this angle point, **Link H2** proceeds in a west/southwesterly direction for approximately 7,800 feet to an angle point. This segment of **Link H2** crosses a crude oil pipeline, US 285, and two natural gas pipelines. From this angle point, **Link H2** proceeds in a southwesterly direction for 1,100 feet to the intersection of **Links H2**, **J21**, and **J22**.

<u>Link I1</u>

From the intersection of **Links F1**, **G1**, and **I1**, **Link I1** proceeds in a south/southwesterly direction for approximately 7,600 feet to an angle point. From this angle point, **Link I1** proceeds in a west/southwesterly direction for approximately 3,000 feet to an angle point. From this angle point, **Link I1** proceeds in a south/southwesterly direction for approximately 34,600 feet to the intersection of **Links I1**, **K11**, and **K2**. This segment of **Link I1** crosses CR 112, four natural gas pipelines, and an existing transmission line.

<u>Link I2</u>

From the intersection of **Links G51**, **G52**, and **I2**, **Link I2** proceeds in a southerly direction for approximately 3,600 feet to an angle point. From this angle point, **Link I2** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 10,100 feet to the intersection of **Links I2**, **I3**, **J1**, and **J21**.

<u>Link I3</u>

From the intersection of **Links G52**, **H1**, and **I3**, **Link I3** proceeds in a southerly direction for approximately 1,200 feet to an angle point. From this angle point, **Link I3** proceeds in a southerly direction for approximately 1,000 feet to an angle point. From this angle point, **Link I3** proceeds in a southerly direction for approximately 8,600 feet to the intersection of **Links I2**, **I3**, **J1**, and **J21**.

<u>Link J1</u>

From the intersection of **Links I2**, **I3**, **J1**, and **J21**, **Link J1** proceeds in a southerly direction for approximately 7,400 feet to an angle point. This segment of **Link J1** crosses a natural gas pipeline and CR 110. From this angle point, **Link J1** proceeds in a south/southwesterly direction for approximately 5,900 feet to an angle point. From this angle point, **Link J1** proceeds in a southeasterly direction for approximately 3,300 feet to an angle point. This segment of **Link J1** crosses FM 2007. From this angle point, **Link J1** proceeds in a southerly direction for approximately 15,300 feet to an angle point. From this angle point, **Link J1** proceeds in a southerly direction for approximately 5,600 feet to an angle point. This segment of **Link J1** crosses CR 112. From this angle point, **Link J1** proceeds in a southerly direction for approximately 12,300 feet to an angle point. This segment of **Link J1** crosses CR 111. From this angle point, **Link J1** proceeds in a southerly direction for approximately 2,200 feet to an angle point. From this angle point, **Link**

J1 proceeds in a southerly direction for approximately 6,100 feet to the intersection **Links J1**, **J5**, **J6**, and **J7**.

Link J21

From the intersection of **Links I2**, **I3**, **J1**, and **J21**, **Link J21** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 4,100 feet to an angle point. From this angle point, **Link J21** proceeds in an east/southeasterly direction for approximately 2,300 feet to an angle point. This segment of **Link J21** crosses FM 2007. From this angle point, **Link J21** proceeds in a southerly direction for approximately 1,100 feet to an angle point. This segment of **Link J21** crosses a natural gas pipeline. From this angle point, **Link J21** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 13,700 feet to the intersection of **Links H2**, **J21**, and **J22**. This segment of **Link J21** crosses three natural gas pipelines.

Link J22

From the intersection of **Links H2**, **J21**, and **J22**, **Link J22** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 2,500 feet to the convergence of **Link J22** to **Link J3**.

Link J3

From the convergence of **Link J22** to **Link J3**, **Link J3** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 5,900 feet to an angle point. From this angle point, **Link J3** proceeds in a southerly direction for approximately 15,000 feet to an angle point. This segment of **Link J3** crosses an existing transmission line and two natural gas pipelines. From this angle point, **Link J3** proceeds in a southeasterly direction for approximately 2,200 feet to an angle point. This segment of **Link J3** crosses a crude oil pipeline. From this angle point, **Link J3** proceeds in a southerly direction for approximately 18,200 feet to the intersection of **Links J3**, **J4**, and **K4**. This segment of **Link J3** crosses the Reeves and Pecos counties boundary.

Link J4

From the intersection of **Links J3**, **J4**, and **K4**, **Link J4** proceeds in a westerly direction for approximately 12,300 feet to the intersection of **Links J4**, **J5**, and **J8**. **Link J4** crosses the Reeves and Pecos counties boundary.

Link J5 (Bi-directional Link)

From the intersection of **Links J4**, **J5**, and **J8**, **Link J5** proceeds in a westerly direction for approximately 10,400 feet to the intersection of **Links J1**, **J5**, **J6**, and **J7**. **Link J5** crosses a crude oil pipeline.

Link J6

From the intersection of **Links J6**, **K2**, and **K3**, **Link J6** proceeds in an easterly direction for approximately 34,000 feet to the intersection of **Links J1**, **J5**, **J6**, and **J7**. **Link J6** crosses an existing transmission line, Barrilla Draw, and two natural gas pipelines.

Link J7

From the intersection of **Links J1**, **J5**, **J6**, and **J7**, **Link J7** proceeds in a southerly direction for approximately 5,800 feet to an angle point. From this angle point, **Link J7** proceeds in a southeasterly direction for approximately 2,400 feet to an angle point. This segment of **Link J7** crosses a crude oil pipeline. From this angle point, **Link J7** proceeds in a southerly direction for approximately 19,100 feet to an angle point. This segment of **Link J7** crosses the Reeves and Pecos counties boundary. From this angle point, **Link J7** proceeds in a south/southeasterly direction for approximately 3,300 feet to an angle point. From this angle point, **Link J7** proceeds in a southerly direction for approximately 3,900 feet to the intersection of **Links J7**, **K5**, and **L1**.

<u>**Link J8**</u>

From the intersection of **Links J4**, **J5**, and **J8**, **Link J8** proceeds in a southerly direction for approximately 19,000 to an angle point. This segment of **Link J8** crosses the Reeves and Pecos county boundaries. From this angle point, **Link J8** proceeds in a south/southeasterly direction for approximately 2,900 feet to the intersection of **Links J8**, **K4**, and **K5**.

<u>**Link K11**</u>

From the intersection of **Links I1**, **K11**, and **K2**, **Link K11** proceeds in a south/southwesterly direction for approximately 7,900 feet to an angle point. This segment of **Link K11** crosses two natural gas pipelines. From this angle point, **Link K11** proceeds in a southwesterly direction for approximately 3,200 feet to an angle point. From this angle point, **Link K11** proceeds in a south/southwesterly direction for approximately 25,400 feet to an angle point. This segment of **Link K11** crosses a natural gas pipeline. From this angle point, **Link K11** proceeds in a south/southeasterly direction for approximately 4,800 feet to an angle point. This segment of **Link K11** crosses CR 310 and an existing transmission line. From this angle point, **Link K11** proceeds in an east/southeasterly direction, parallel to an existing transmission line, for approximately 2,100 feet to an angle point. From this angle point, **Link K11** proceeds in an east/southeasterly direction, parallel to an existing transmission line, for approximately 42,200 feet to an angle point. This segment of **Link K11** crosses Barrilla Draw. From this angle point, **Link K11** proceeds in a south/southeasterly direction for approximately 1,200 feet to an angle point. From this angle point, **Link K11** proceeds in an easterly direction for approximately 2,300 feet to an angle point. From this angle point, **Link K11** proceeds in an east/southeasterly direction, parallel to an existing transmission line, for approximately 14,000 feet to an angle point. This segment of **Link K11** crosses the Reeves and Pecos counties boundary. From this angle point, **Link K11** proceeds in an easterly direction for approximately 1,700 feet to the intersection of **Links K11**, **K12**, and **K3**. This segment of **Link K11** crosses an existing transmission line.

<u>**Link K12**</u>

From the intersection of **Links K11**, **K12**, and **K3**, **Link K12** proceeds in an easterly direction for approximately 500 feet to a point of convergence of **Link K12** to **Link L2**.

<u>**Link K2**</u>

From the intersection of **Links I1**, **K11**, and **K2**, **Link K2** proceeds in a southeasterly direction for approximately 3,300 feet to an angle point. This segment of **Link K2** crosses a natural gas pipeline. From this angle point, **Link K2** proceeds in a southeasterly direction for approximately 7,800 feet to an angle point. These two segments of **Link K2** parallel an existing transmission line. From this angle point, **Link K2** proceeds in a south/southwesterly direction for approximately 2,100 feet to an angle point. From this angle point, **Link K2** proceeds in an east/southeasterly direction for approximately 2,100 feet to an angle point. From this angle point, **Link K2** proceeds in a south/southeasterly direction, parallel to an existing transmission line, for approximately 3,600 feet to an angle point. From this angle point, **Link K2** proceeds in a south/southwesterly direction for approximately 1,200 feet to an angle point. From this angle point, **Link K2** proceeds in an east/southeasterly direction for approximately 1,200 feet to an angle point. From this angle point, **Link K2** proceeds in a south/southeasterly direction, parallel to an existing transmission line, for approximately 10,400 feet to the intersection of **Links J6**, **K2**, and **K3.**

<u>**Link K3**</u>

From the intersection of **Links J6**, **K2**, and **K3**, **Link K3** proceeds in a south/southeasterly direction for approximately 10,700 feet to an angle point. This segment of **Link K3** crosses a natural gas pipeline. From this angle point, **Link K3** proceeds in a southeasterly direction for approximately 2,000 feet to an angle point. Up to this angle point, **Link K3** has paralleled an existing transmission line. From this angle point,

Link K3 proceeds in a southerly direction for approximately 2,400 feet to an angle point. From this angle point, **Link K3** proceeds in an east/southeasterly direction for approximately 3,200 feet to an angle point. This segment of **Link K3** crosses Barrilla Draw. From this angle point, **Link K3** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 5,000 feet to an angle point. This segment of **Link K3** crosses Barrilla Draw. From this angle point, **Link K3** proceeds in a southerly direction for approximately 1,200 feet to an angle point. This segment of **Link K3** crosses a natural gas pipeline. From this angle point, **Link K3** proceeds in an east/southeasterly direction for approximately 2,000 feet to an angle point. From this angle point, **Link K3** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 4,000 feet to an angle point. From this angle point, **Link K3** proceeds in a southerly direction for approximately 4,600 feet to an angle point. From this angle point, **Link K3** proceeds in an easterly direction for approximately 4,200 feet to an angle point. From this angle point, **Link K3** proceeds in a southeasterly direction, parallel to an existing transmission line, for approximately 14,400 feet to an angle point. This segment of **Link K3** crosses the Reeves and Pecos counties boundary. From this angle point, **Link K3** proceeds in a south/southeasterly direction for approximately 1,800 feet to the intersection of **Links K11**, **K12**, and **K3**.

<u>Link K4</u>

From the intersection of **Links J3**, **J4**, and **K4**, **Link K4** proceeds in a southerly direction for approximately 4,600 feet to an angle point. From this angle point, **Link K4** proceeds in a southwesterly direction for approximately 3,600 feet to an angle point. From this angle point, **Link K4** proceeds in a southerly direction for approximately 2,100 feet to an angle point. From this angle point, **Link K4** proceeds in a south/southwesterly direction, parallel to an existing transmission line, for approximately 14,500 feet to the intersection of **Links J8**, **K4**, and **K5**.

<u>Link K5</u>

From the intersection of **Links J8**, **K4**, and **K5**, **Link K5** proceeds in a south/southwesterly direction, parallel to an existing transmission line, for approximately 13,700 feet to an angle point. From this angle point, **Link K5** proceeds in a westerly direction for approximately 3,200 feet to the intersection of **Links J7**, **K5**, and **L1**.

<u>Link L1</u>

From the intersection of **Links J7**, **K5**, and **L1**, **Link L1** proceeds in a southerly direction for approximately 5,300 feet to the intersection of **Links L1**, **L2**, and **Z**.

<u>Link L2</u>

From the point of convergence of **Link K12** to **Link L2**, **Link L2** proceeds in an easterly direction for approximately 2,200 feet to the intersection of **Links L1**, **L2**, and **Z**. **Link L2** crosses an existing transmission line.

<u>Link Z</u>

From the intersection of **Links L1**, **L2**, and **Z**, **Link Z** proceeds in an easterly direction for approximately 900 feet to an angle point. This segment of **Link Z** crosses two existing transmission lines. From this angle point, **Link Z** proceeds in a southerly direction for approximately 1,000 feet to an angle point. This segment of **Link Z** crosses an existing transmission line. From this angle point, **Link Z** proceeds in a southerly direction for approximately 300 feet to the Solstice Station.

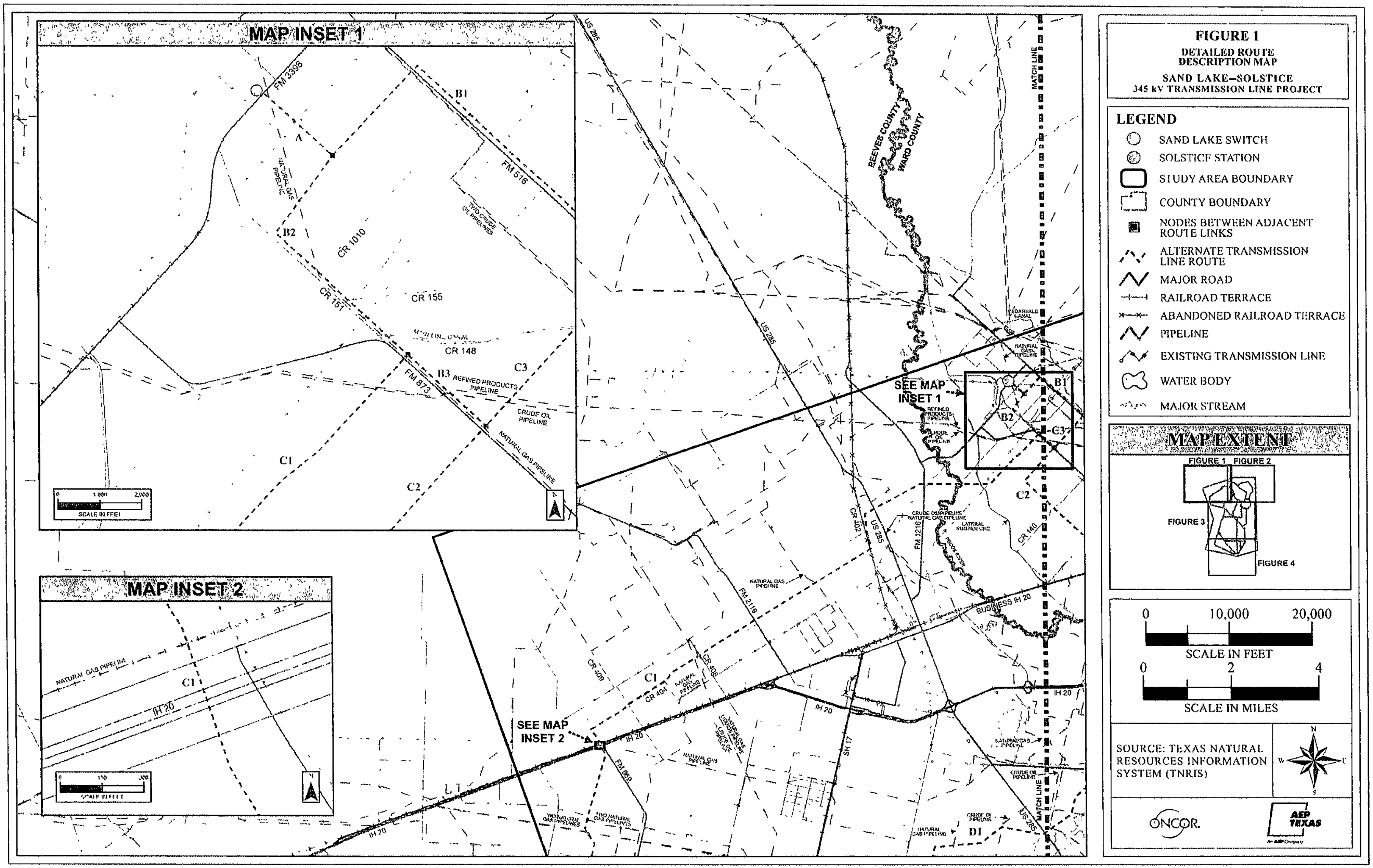
FIGURE 1
DETAILED ROUTE DESCRIPTION MAP
SAND LAKE–SOLSTICE
345 kV TRANSMISSION LINE PROJECT
LEGEND
SAND LAKE SWITCH
SOLSTICE STATION
STUDY AREA BOUNDARY
COUNTY BOUNDARY
NODES BETWEEN ADJACENT ROUTE LINKS
ALTERNATE TRANSMISSION LINE ROUTE
MAJOR ROAD
RAILROAD TERRACE
ABANDONED RAILROAD TERRACE
PIPELINE
EXISTING TRANSMISSION LINE
WATER BODY
MAJOR STREAM
MAP EXTENT
FIGURE 1
FIGURE 2
FIGURE 3
FIGURE 4
0
10,000
20,000
SCALE IN FEET
0
2
4
SCALE IN MILES
SOURCE: TEXAS NATURAL RESOURCES INFORMATION SYSTEM (TNRIS)
ONCOR
AEP TEXAS
MAP INSET 1
FM 3398
B1
A
FM 516
NATURAL GAS PIPELINE
TWO CRUDE OIL PIPELINES
B2
CR 1010
CR 151
CR 155
CR 148
C3
B3
FM 873
REFINED PRODUCTS PIPELINE
CRUDE OIL PIPELINE
NATURAL GAS PIPELINE
C1
C2
SCALE IN FEET
MAP INSET 2
NATURAL GAS PIPELINE
C1
IH 20
US 285
REEVES COUNTY
WARD COUNTY
MATCH LINE
SEE MAP INSET 1
SEE MAP INSET 2
CR 402
FM 1216
CR 140
FM 2119
BUSINESS IH 20
CR 409
CR 404
CR 408
SH 17
FM 869
IH 20
D1